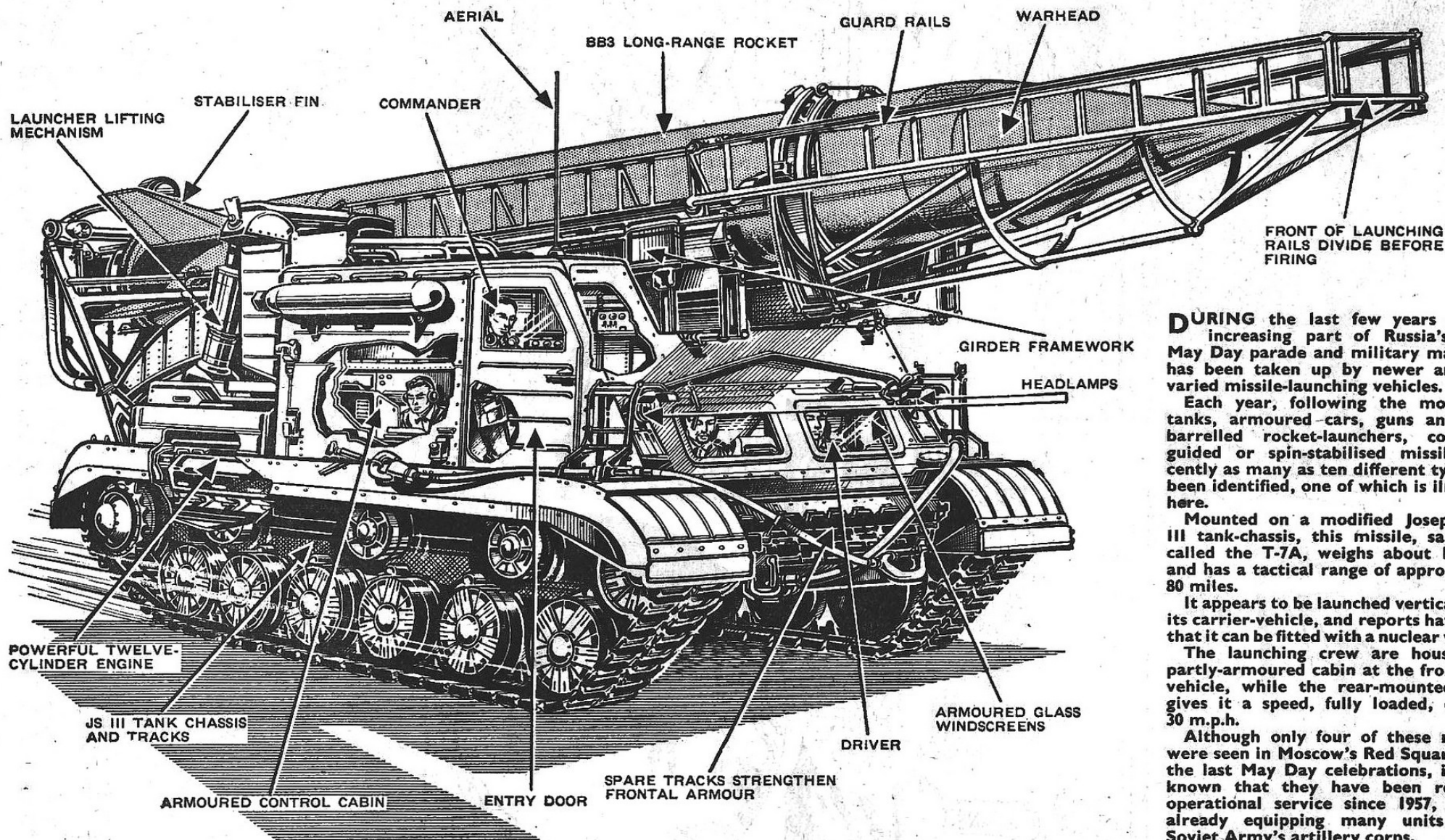


RUSSIA'S JS Mk.B ROCKET-LAUNCHER



DURING the last few years an ever-increasing part of Russia's mighty May Day parade and military march-past has been taken up by newer and more varied missile-launching vehicles.

Each year, following the more usual tanks, armoured cars, guns and multi-barrelled rocket-launchers, come the guided or spin-stabilised missiles. Recently as many as ten different types have been identified, one of which is illustrated here.

Mounted on a modified Joseph Stalin III tank-chassis, this missile, said to be called the T-7A, weighs about 10,000 lb. and has a tactical range of approximately 80 miles.

It appears to be launched vertically from its carrier-vehicle, and reports have stated that it can be fitted with a nuclear warhead.

The launching crew are housed in a partly-armoured cabin at the front of the vehicle, while the rear-mounted motor gives it a speed, fully loaded, of about 30 m.p.h.

Although only four of these machines were seen in Moscow's Red Square during the last May Day celebrations, it is now known that they have been ready for operational service since 1957, and are already equipping many units of the Soviet Army's artillery corps.

IN NEXT MONDAY'S *LION* — A SUPER PICTURE OF AN ARMOURD CAR USED IN THE NORTH AFRICAN DESERT WAR!

FRENCH VISTA-DOME RAILCARS

Twenty of these 'panoramic', or vista-dome, railcars of the French National Railways - Société Nationale Des Chemins De Fer Français - have been designed for high-speed services on certain lines of scenic beauty for tourists. A unique feature is the double-deck construction, seating at the two ends being at normal level while, in the centre, the floor is raised over the power equipment. This centre portion gives an excellent view in all directions, hence the term 'vista-dome'.

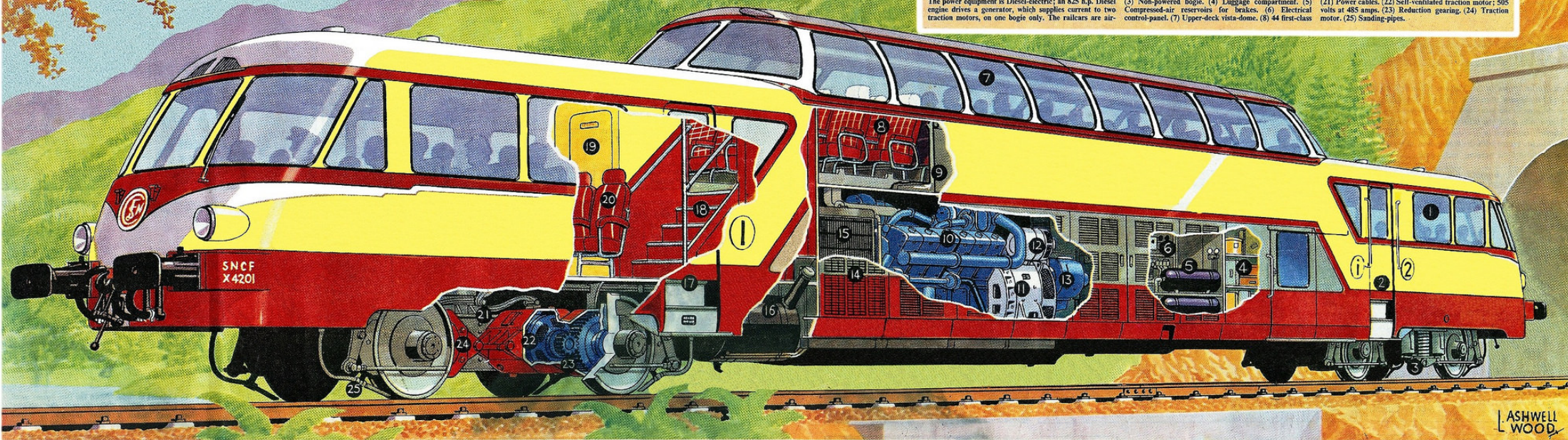
The power equipment is Diesel-electric; an 825 h.p. Diesel engine drives a generator, which supplies current to two traction motors, on one bogie only. The railcars are air-

conditioned, and top speed is over 80 m.p.h. There are 44 second-class seats on the lower deck, and 44 first-class seats on the upper deck. Perhaps some EAGLE readers will be lucky enough to use these railcars whilst on holiday in France this summer.

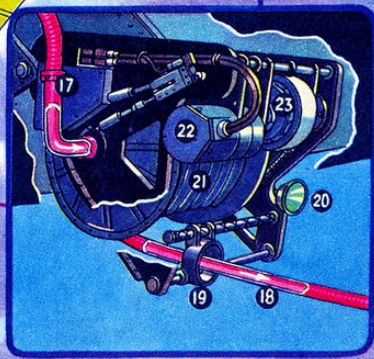
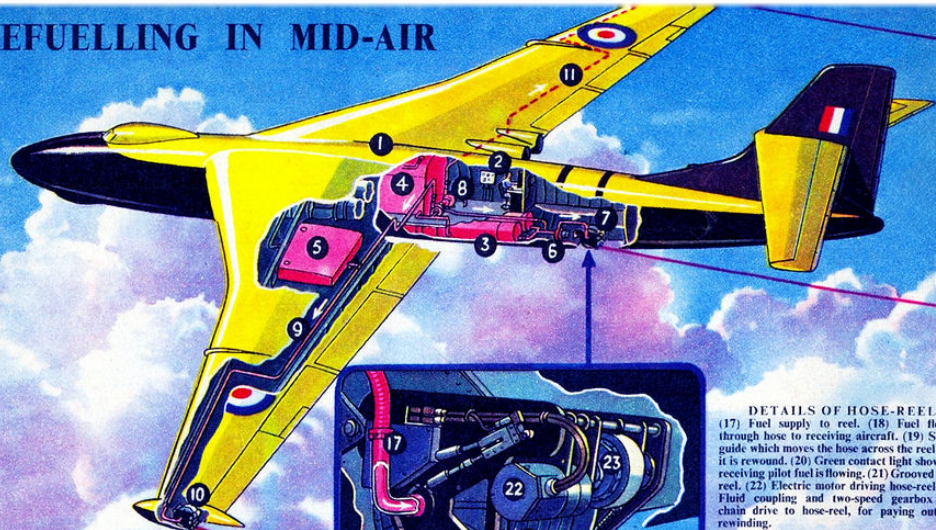
KEY TO NUMBERED PARTS

(1) Second-class end-saloon; 22 seats. (2) Entrance door. (3) Non-powered bogie. (4) Luggage compartment. (5) Compressed-air reservoirs for brakes. (6) Electrical control-panel. (7) Upper-deck vista-dome. (8) 44 first-class

reversible seats. (9) Air-conditioning vents. (10) 825 h.p. M.G.O. twelve-cylinder ('V' type) Diesel engine. (11) Main generator; 505 volts at 970 amps. (12) Auxiliary generator for lighting, etc., at 100 volts. (13) Air compressor. (14) Engine air-inlet grilles. (15) Engine-cooling radiator. (16) One of three fuel tanks; total capacity, 1,500 litres (330 gallons). (17) Entrance door and steps. (18) Stairs to upper deck (provided at each end). (19) Toilet cubicle. (20) Second-class end-saloon; 22 seats. (21) Power cables. (22) Self-ventilated traction motor; 505 volts at 485 amps. (23) Reduction gearing. (24) Traction motor. (25) Sanding-pipes.

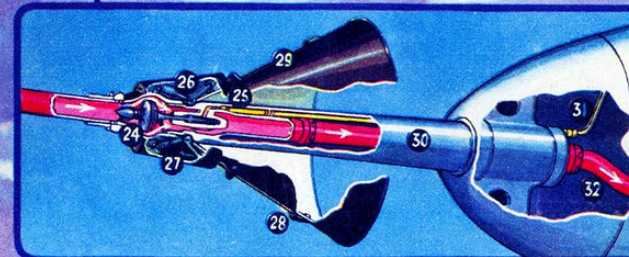


REFUELLING IN MID-AIR



DETAILS OF HOSE-REEL

(17) Fuel supply to reel. (18) Fuel flowing through hose to receiving aircraft. (19) Sliding guide which moves the hose across the reel when it is rewound. (20) Green contact light shows the receiving pilot fuel is flowing. (21) Grooved hose-reel. (22) Electric motor driving hose-reel. (23) Fluid coupling and two-speed gearbox with chain drive to hose-reel, for paying out and rewinding.



DETAILS OF PROBE AND DROGUE

(24) Spring loaded shut-off valve of drogue is pushed back by valve of probe, which is operated by receiving pilot, and fuel flows. (25) Hydraulic pipe line to probe valve. (26) Spring toggles gripping the probe in position. (27) Small battery for drogue lighting. (28) Lights inside drogue for night operation. (29) Drogue. (30) Probe. (31) Hydraulic pipe line from cockpit. (32) Fuel flowing to tanks of receiving aircraft. The pilot is warned when these are nearly full; he eases his machine back and contact is broken. The spring loaded shut-off valve in the drogue closes and the flow ceases.

A mother bird feeding her young birds on the wing could be an apt description of this scene, which shows a Vickers-Armstrong *Valiant* bomber refuelling three *Gloster Meteor* M.8 fighters. This method of refuelling aircraft in flight, known as the probe and drogue, has been developed by a British firm, Flight Refuelling Ltd. The two principal pieces of equipment enabling the refuelling contact to be made are respectively a probe, or projection, on the receiving aircraft, and a drogue trailed by the tanker aircraft at the end of a length of hose. The receiving pilot merely flies the probe into the drogue. As it makes contact it is gripped by spring toggles, a valve automatically opens and the fuel starts to flow between the two aircraft. Refuelling takes place at the rate of 200 to 500 gallons a minute. When the receiving aircraft's tanks are full, the pilot eases back his machine until his probe disengages, which automatically stops the flow of fuel from the tanker, the hose rewinds on to its power-operated reel in the tanker and the operation is complete.

This system enables aircraft to remain in the air for long periods and also increases their range.

KEY TO HOW IT IS DONE

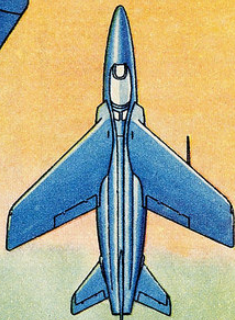
(1) Tanker aircraft with three-point refuelling. (11) Fuel pipe line to starboard wing-tip hose-reel. (12) Probe of receiving aircraft about to make contact with starboard drogue. (13) Contact made with middle drogue and fuel flowing. (14) Tanks receiving fuel. (15) Contact made with port drogue and fuel flowing. (16) Tanks receiving fuel.

A SUPERSONIC LIGHT JET FIGHTER

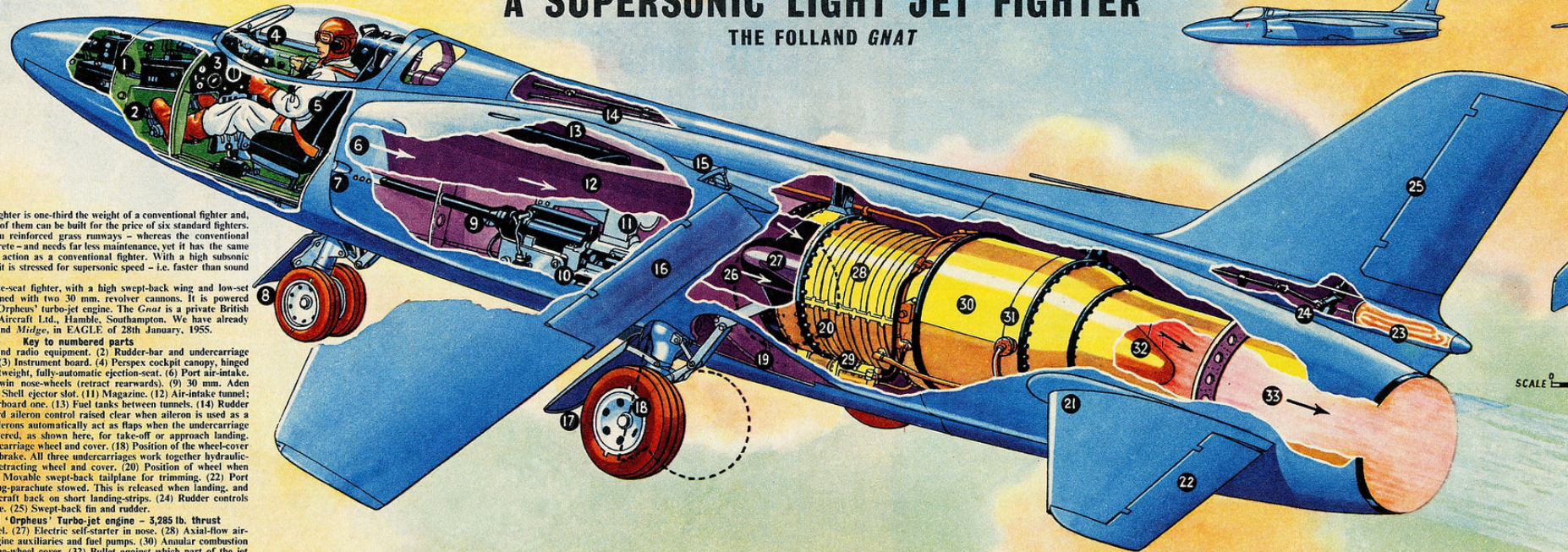
THE FOLLAND GNAT



The Folland Gnat Light Jet Fighter
Length: 29ft. 9ins.
Span: 22ft. 2ins.
Height: 8ft. 10ins.
(undercarriage down)



SCALE 0 5 10 15 20 FEET



The Gnat light jet fighter is one-third the weight of a conventional fighter and, it is claimed, twenty of them can be built for the price of six standard fighters. It can be flown from reinforced grass runways - whereas the conventional fighter requires concrete - and needs far less maintenance, yet it has the same speed and radius of action as a conventional fighter. With a high subsonic speed in level flight, it is stressed for supersonic speed - i.e. faster than sound in a shallow dive.

The Gnat is a single-seat fighter, with a high swept-back wing and low-set tailplane, and is armed with two 30 mm. revolver cannons. It is powered by the new Bristol 'Orpheus' turbo-jet engine. The Gnat is a private British venture by Folland Aircraft Ltd., Hamble, Southampton. We have already shown you the Folland Midge, in EAGLE of 28th January, 1955.

Key to numbered parts

(1) Radar-ranging and radio equipment. (2) Rudder-bar and undercarriage wheel-brake pedals. (3) Instrument board. (4) Perspex cockpit canopy, hinged at the rear. (5) Lightweight, fully-automatic ejection-seat. (6) Port air-intake. (7) Gun slot. (8) Twin nose-wheels (retract rearwards). (9) 30 mm. Aden revolver cannon. (10) Shell ejector slot. (11) Magazine. (12) Air-intake tunnel; joins up with the starboard one. (13) Fuel tanks between tunnels. (14) Rudder controls. (15) Inboard aileron control raised clear when aileron is used as a flap. (16) Inboard ailerons automatically act as flaps when the undercarriage wheels are fully lowered, as shown here, for take-off or approach landing. (17) Port main undercarriage wheel and cover. (18) Position of the wheel-cover when used as an air brake. All three undercarriages work together hydraulically. (19) Slot for retracting wheel and cover. (20) Position of wheel when fully retracted. (21) Movable swept-back tailplane for trimming. (22) Port elevator. (23) Braking-parachute stowed. This is released when landing, and helps to pull the aircraft back on short landing-strips. (24) Rudder controls and parachute release. (25) Swept-back fin and rudder.

Key to Bristol 'Orpheus' Turbo-jet engine - 3,285 lb. thrust

(26) Air-intake tunnel. (27) Electric self-starter in nose. (28) Axial-flow air-compressor. (29) Engine auxiliaries and fuel pumps. (30) Annular combustion chamber. (31) Turbine-wheel cover. (32) Bullet against which part of the jet thrust reacts. (33) Jet exhaust tube.

DOUGLAS D558-2 SKYROCKET

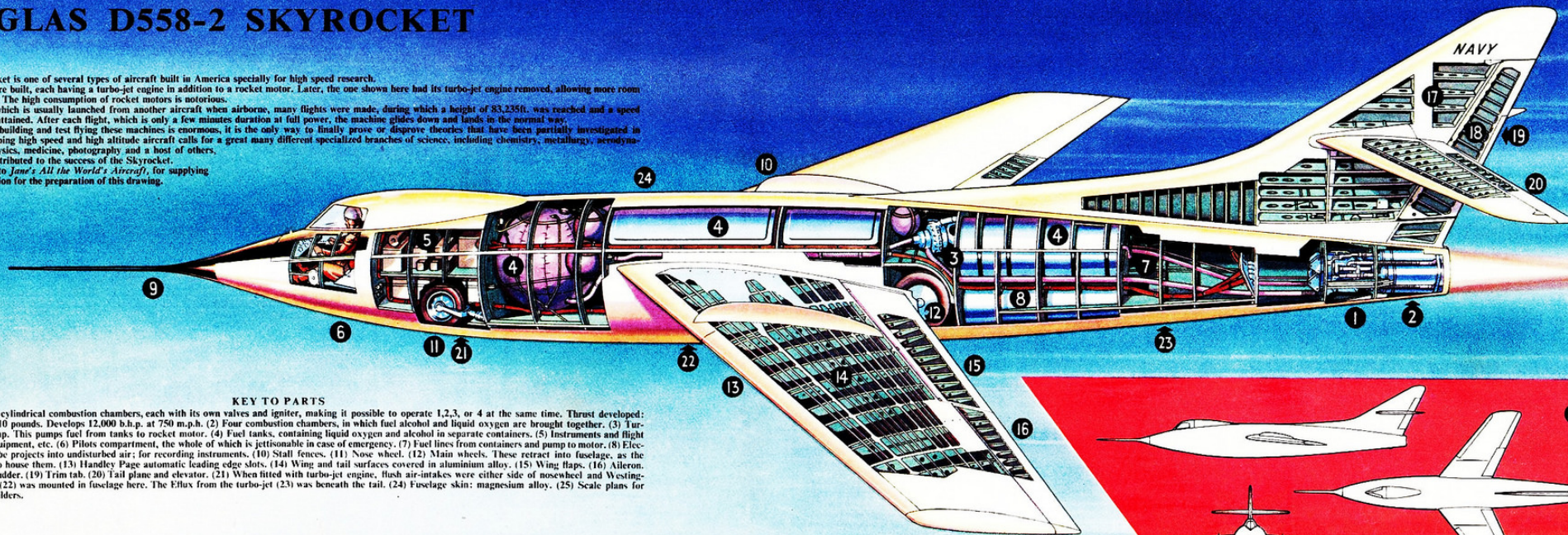
The Douglas Skyrocket is one of several types of aircraft built in America specially for high speed research.

Three Skyrockets were built, each having a turbo-jet engine in addition to a rocket motor. Later, the one shown here had its turbo-jet engine removed, allowing more room for extra rocket fuel. The high consumption of rocket motors is notorious.

With this machine, which is usually launched from another aircraft when airborne, many flights were made, during which a height of 83,235ft. was reached and a speed of 1,272 m.p.h. was attained. After each flight, which is only a few minutes duration at full power, the machine glides down and lands in the normal way.

Although the cost of building and test flying these machines is enormous, it is the only way to finally prove or disprove theories that have been partially investigated in wind tunnels. Developing high speed and high altitude aircraft calls for a great many different specialized branches of science, including chemistry, metallurgy, aerodynamics, electronics, physics, medicine, photography and a host of others, all of which have contributed to the success of the Skyrocket.

Our thanks are due to *Jane's All the World's Aircraft*, for supplying much of the information for the preparation of this drawing.



KEY TO PARTS

(1) MOTOR: Four cylindrical combustion chambers, each with its own valves and igniter, making it possible to operate 1,2,3, or 4 at the same time. Thrust developed: 6,000 lbs. Weight 210 pounds. Develops 12,000 b.h.p. at 750 m.p.h. (2) Four combustion chambers, in which fuel alcohol and liquid oxygen are brought together. (3) Turbine driven fuel pump. This pumps fuel from tanks to rocket motor. (4) Fuel tanks, containing liquid oxygen and alcohol in separate containers. (5) Instruments and flight testing recording equipment, etc. (6) Pilots compartment, the whole of which is jettisonable in case of emergency. (7) Fuel lines from containers and pump to motor. (8) Electrical leads. (9) Probe projects into undisturbed air; for recording instruments. (10) Stall fences. (11) Nose wheel. (12) Main wheels. These retract into fuselage, as the wings are too thin to house them. (13) Handley Page automatic leading edge slots. (14) Wing and tail surfaces covered in aluminium alloy. (15) Wing flaps. (16) Aileron. (17) Tail fin. (18) Rudder. (19) Trim tab. (20) Tail plane and elevator. (21) When fitted with turbo-jet engine, flush air-intakes were either side of nosewheel and Westinghouse J34 turbo-jet (22) was mounted in fuselage here. The Efflux from the turbo-jet (23) was beneath the tail. (24) Fuselage skin: magnesium alloy. (25) Scale plans for the use of model builders.

THE FIRST TRANSATLANTIC AIRLINER BRITISH AIRSHIP R34

DIMENSIONS: Length, 643.5ft. Beam, 79ft. Height, 91.8ft.

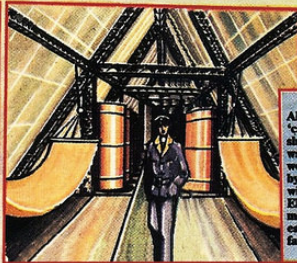


KEY TO NUMBERED PARTS

(1) Mooring-rope tub. (2) Emergency water-ballast discharge. (3) Hammocks. (4) Access tube leading to (5) the forward gun-platform. (6) Openings of corridor ventilating shafts. (7) One of the giant gas-bags. Each of these drum-shaped gas-bags contained several thousand cubic feet of highly inflammable hydrogen. (8) Rigid framework of duralumin girders. (9) Access trunk to (10) the control cabin, which also combined the forward power-car. (11) Compressed-air landing bags. (12) Fuel tanks. (13) Drinking-water tanks, each containing 30 gallons. (14) Larder and stores. (15) Triangular space running the length of the keel. (16) Keel and 'cat-walk'. The latter is a narrow walking-way, running the length of the keel inside the ship. (17)

Water-ballast bag. (18) Crew space. (19) The starboard wing power-car; another (not shown) is positioned opposite to this, on the port side. These 'wing' cars were along a little way up either side of the hull. (20) Access trunk to the aft power-car. Two engines were coupled together in this car, which also housed auxiliary controls, for use in case the steering broke down forward. (21) Adjustable radiators. (22) Oil radiator. (23) Handling rail for ground crews. (24) Engine exhaust silencer. (25) Navigation light - known as the 'steaming' light. (26) Propeller, 19 ft. 6 ins. from tip to tip. (27) Outer envelope of varnished fabric. (28) Rudders. (29) Elevators. (30) Landing skid.

The crew space of R34. On the right can be seen two of the 30-gallon drinking-water tanks and, beyond the curtained partition, a glimpse of some of the fuel tanks. Food was cooked by engine exhaust in the engine-cars.



Along each side of the keel and 'cat-walk', hammocks were slung. The 'cat-walk' itself was a girder covered with plywood. In the crew space, and by the hammocks, the whole width of the keel was floored in. Elsewhere, the 'cat-walk' was merely a narrow foot-way, on each side of which was just the fabric outer-cover of the ship!

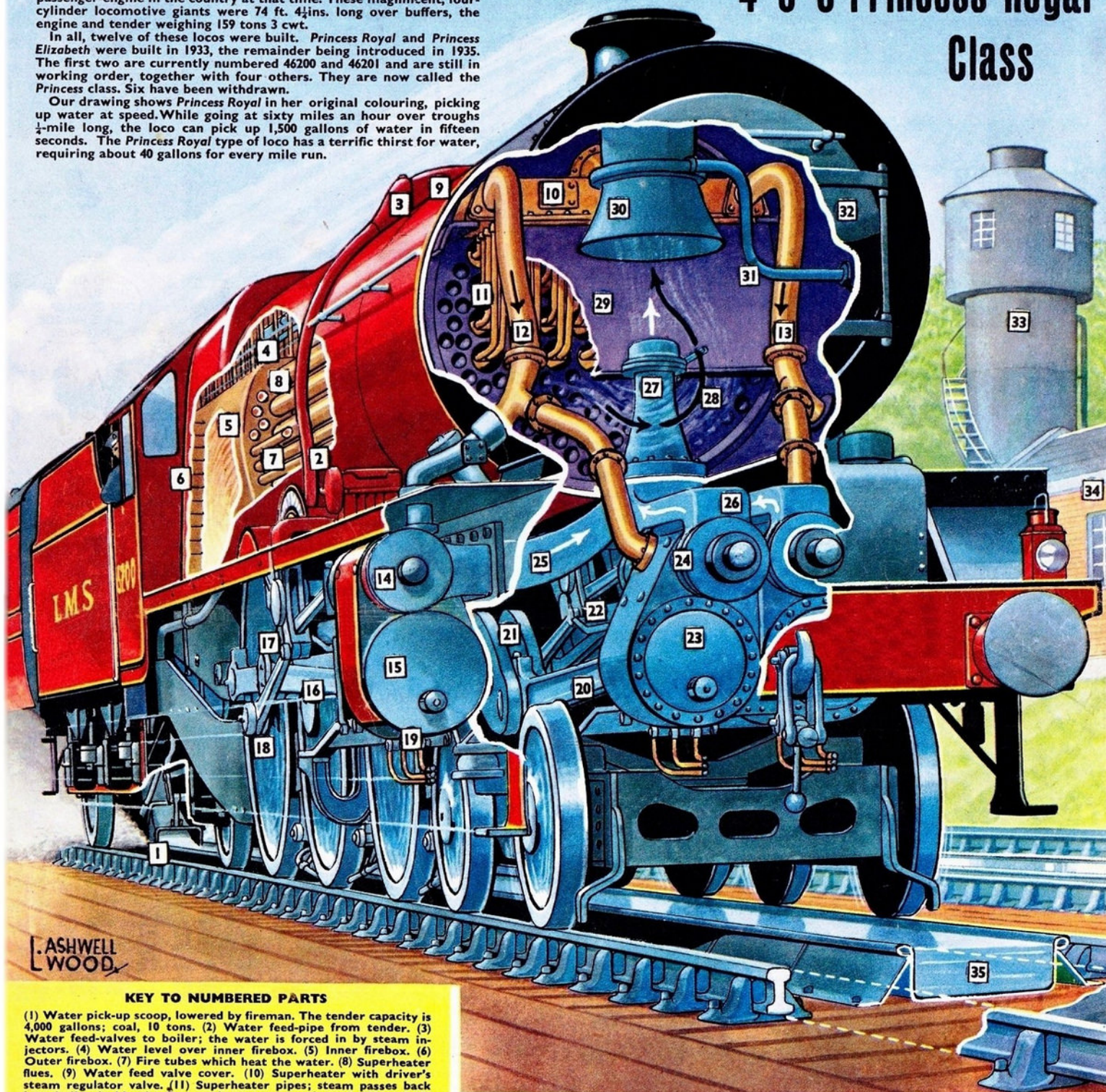
FAMOUS LOCOMOTIVE TYPES

4-6-0 Princess Royal Class

Introduced in 1933, the famous *Princess Royal* class of locomotive, of the then L.M.S. railway, was the most powerful, and largest, express passenger-engine in the country at that time. These magnificent, four-cylinder locomotive giants were 74 ft. 4½ ins. long over buffers, the engine and tender weighing 159 tons 3 cwt.

In all, twelve of these locos were built. *Princess Royal* and *Princess Elizabeth* were built in 1933, the remainder being introduced in 1935. The first two are currently numbered 46200 and 46201 and are still in working order, together with four others. They are now called the *Princess* class. Six have been withdrawn.

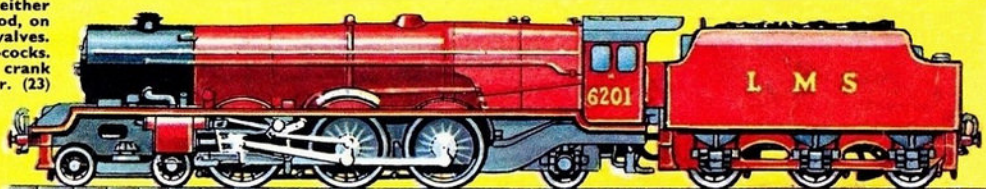
Our drawing shows *Princess Royal* in her original colouring, picking up water at speed. While going at sixty miles an hour over troughs ¼-mile long, the loco can pick up 1,500 gallons of water in fifteen seconds. The *Princess Royal* type of loco has a terrific thirst for water, requiring about 40 gallons for every mile run.



ASHWELL
WOOD

KEY TO NUMBERED PARTS

(1) Water pick-up scoop, lowered by fireman. The tender capacity is 4,000 gallons; coal, 10 tons. (2) Water feed-pipe from tender. (3) Water feed-valves to boiler; the water is forced in by steam injectors. (4) Water level over inner firebox. (5) Inner firebox. (6) Outer firebox. (7) Fire tubes which heat the water. (8) Superheater flues. (9) Water feed valve cover. (10) Superheater with driver's steam regulator valve. (11) Superheater pipes; steam passes back into boiler inside the flues and returns superheated. (12 and 13) Superheated steam-pipes to inside and outside cylinders. (14) Outside-cylinder piston-valves; these admit steam alternately either side of piston. (15) Piston cylinder. (16) Outside connecting-rod, on forward stroke. (17) Walschaerts gear for working piston-valves. (18) Crank for working valve gear. (19) Cylinder-water drain-cocks. (20) Inside connecting rod, on backward stroke. (21) Balance crank on front driving-wheel axle. (22) Inside-cylinder valve gear. (23) Inside piston cylinder. (24) Inside-cylinder piston-valves. (25) Outside-cylinder steam exhaust to blast-pipe. (26) Inside cylinder's steam exhaust. (27) Steam exhaust blast-pipe. (28) Path of hot gases and smoke from firebox, created by the vacuum in smokebox. (29) Spark shield. (30) Chimney cowl. (31) Exhaust steam-pipe from vacuum brake ejector; this creates the vacuum for the brakes. (32) Smokebox door. (33) Water softening tower; this supplies water to pick-up troughs. (34) Pump house. (35) Section of water-trough - 6 ins. deep, 1 ft. 6 ins. wide.



PRINCESS ELIZABETH

The *Princess Elizabeth* had slight modifications - a steam-dome on the boiler and a high-sided

tender. In November, 1936, this locomotive covered the 401.4 miles from Glasgow to London non-stop at an average speed of 70.3 m.p.h.

MISSED BY FEET!

This thrilling flying feat performed by two pilots of the famous 'Red Arrows', the Royal Air Force Acrobatic Team, is known as the 'Roulette'. Two Gnat jet trainers, flying low down, approach one another almost head-on at a combined speed of 800 m.p.h. The highly-maneuvrable red-painted aircraft pass within 16 feet of each other. This requires great skill and split-second timing. The Red Arrow aerobatic team and its Hawker Siddeley Gnat T.MK1 advanced jet trainers belong to the R.A.F. Central Flying School, Little Rissington, Gloucestershire.

This year, in celebration of the 50th anniversary of the R.A.F., they have performed at Malta, in the Mediterranean, and at Abingdon, England, in the presence of H.M. The Queen. They will also appear at other places, including the Farnborough air display, in September. The Gnat jet trainer is powered by a Bristol Siddeley Orpheus 101 turbojet engine of 4,520 pounds thrust, giving a top speed of 600 m.p.h. Span: 24 ft. Length: 31 ft.

'Arrow' — another of the Red Arrow formations. Others are: 'Big T'; 'Vixon'; 'Half Swan'; 'King's Cross' and 'Rhombus'.

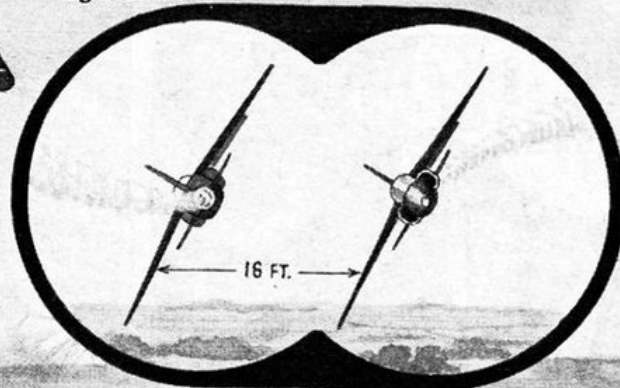
AN EAGLE
cutaway
DRAWING

LASHWELL
WOOD

(1) Pressure head for air speed indication. (2) Landing light. (3) Gyroscope. (4) Radio. (5) Crest of the Central Flying School. (6) Plastic cockpit canopy. (7) Pilot's ejection seat. There is another seat behind for use as a two-seater trainer. (8) Port air intake to engine. (9) Nose wheels retracted. (10) Fuselage fuel tanks. (11) Bifurcated (split) air intake trunks to engine. (12) Port main undercarriage wheel retracted. (13) Flap-operating jack. (14) Wing fuel tanks. Total fuel capacity—264 gallons. (15) Swept-back wings. (16) Navigation lights. (17) Aileron. (18) Aileron operating jack. (19) Port wing flaps lowered. The starboard wing flap is lowered on the other aircraft; this

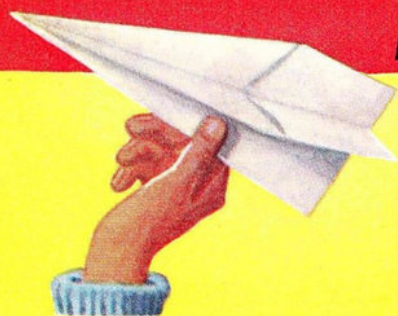
gives them the close angle of approach (see diagram on right). (20) Air compressor casing of Bristol Siddeley Orpheus turbojet engine. (21) One of 7 combustion chambers and fuel burners. (22) Turbine wheel shaft driving air compressors. (23) Turbine wheel driven by ignited gases of air and fuel. (24) Jet cone against which the hot, expanding gases react, thus giving forward thrust. (25) Jet exhaust pipe. (26) Smoke mixture control. During flying displays, trailing coloured smoke is emitted from the exhaust. (27) Elevators. (28) Parachute container. Trailing braking parachute is used on landing. (29) Tail plane pivot. (30) Swept-back fin and rudder. (31) Navigation light.

'Roulette' — the formation of two Gnats passing low down at high speed on opposing courses



FLYING DART

THE SHAPE OF
THINGS TO COME



Handley Page H.P. 115 Supersonic Research Aircraft

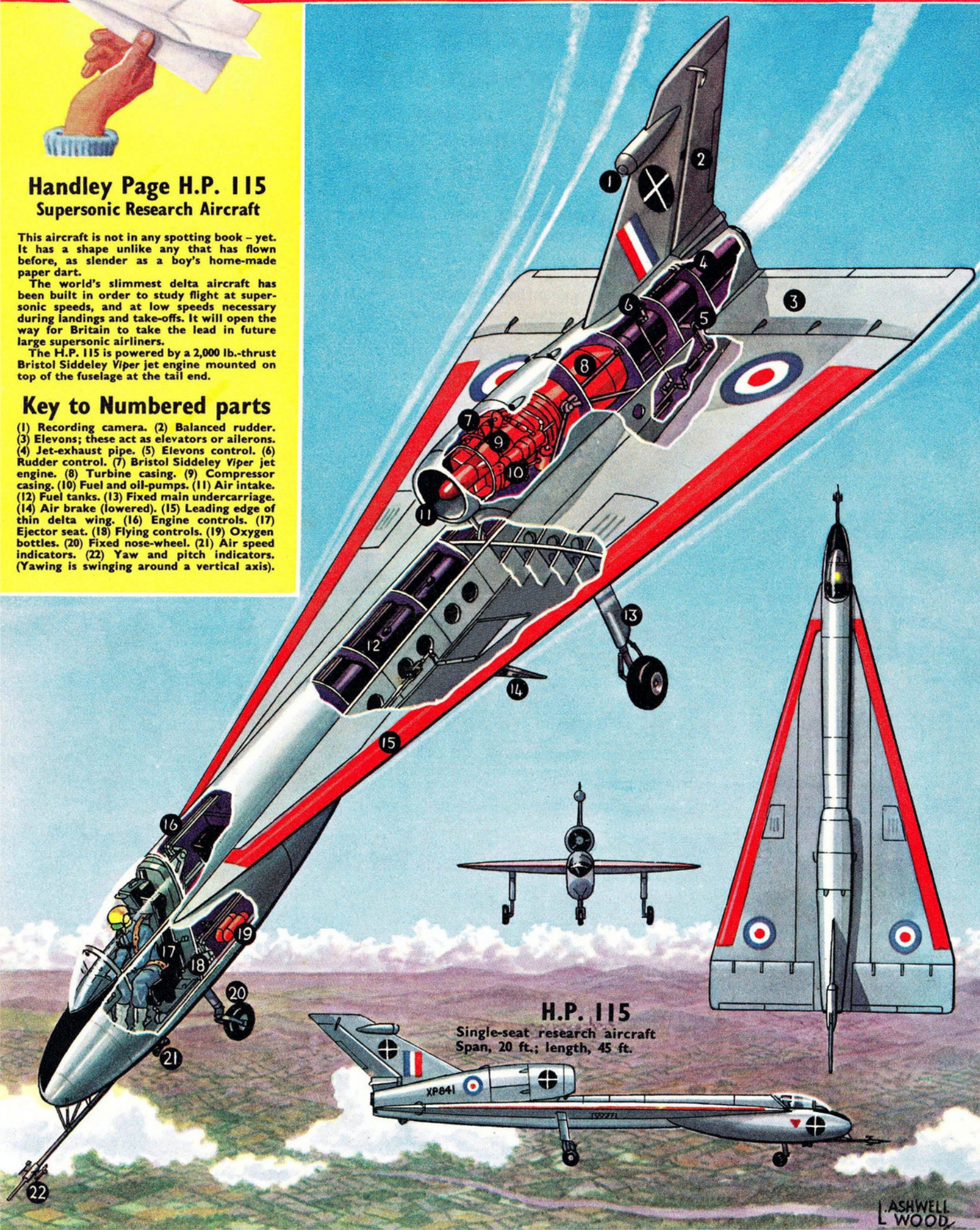
This aircraft is not in any spotting book – yet. It has a shape unlike any that has flown before, as slender as a boy's home-made paper dart.

The world's slimmest delta aircraft has been built in order to study flight at supersonic speeds, and at low speeds necessary during landings and take-offs. It will open the way for Britain to take the lead in future large supersonic airliners.

The H.P. 115 is powered by a 2,000 lb.-thrust Bristol Siddeley Viper jet engine mounted on top of the fuselage at the tail end.

Key to Numbered parts

- (1) Recording camera. (2) Balanced rudder.
- (3) Elevons; these act as elevators or ailerons.
- (4) Jet-exhaust pipe. (5) Elevons control. (6) Rudder control. (7) Bristol Siddeley Viper jet engine. (8) Turbine casing. (9) Compressor casing. (10) Fuel and oil-pumps. (11) Air intake. (12) Fuel tanks. (13) Fixed main undercarriage.
- (14) Air brake (lowered). (15) Leading edge of thin delta wing. (16) Engine controls. (17) Ejector seat. (18) Flying controls. (19) Oxygen bottles. (20) Fixed nose-wheel. (21) Air speed indicators. (22) Yaw and pitch indicators. (Yawing is swinging around a vertical axis).



H.P. 115

Single-seat research aircraft
Span, 20 ft.; length, 45 ft.

L. ASHVELL
L. WOOD

VICKERS VC-10

A SUPERB NEW AIRLINER

A faster-and-farther four-jet-engined British airliner, to beat the big American Boeing 707 and Douglas DC-8, is now under construction at Weybridge by Vickers-Armstrongs. At present unnamed, and known only by the maker's designation, VC-10, it will be powered by four Rolls Royce *Conway* by-pass turbo-jets. It is the first airliner to have four engines mounted at the tail-end of the fuselage, two on each side. This leaves the wings clear for higher flying performance, and reduces noise in the passenger cabin. A contract of £60,000,000 has been placed for 35 of these aircraft by B.O.A.C. They will be capable of carrying 150 passengers between London and New York, cruising at over 600 m.p.h. This special, up-to-the-minute EAGLE drawing shows the VC-10 as it will be when completed.

KEY TO NUMBERED PARTS: (1) Flight deck for a crew of five - Captain, Co-pilot, Flight engineer, Navigator, Radio operator. (2) Crew's toilet. (3) Passenger and crew entrance. (4) Pantry. (5) Forward retracting nose-wheels. (6) Main equipment and electronic bay. (7) Forward freight hold. (8) Forward passenger cabin; six abreast seating in the 150-seat layout. (9) Passenger entrance. (10) Pod can be fitted on starboard wing to carry spare engine. (11) Wing slats (shown open). (12) Fuel-tank cells. Total capacity in both wings - 17,300 gallons. (13) Air brakes (closed). (14) Flaps (closed). (15) Inward retracting main undercarriage. (16) Rear passenger cabin. (17) Double skin of pressurized fuselage. (18) Servicing and emergency door. (19) Rear toilets (three). (20) Air conditioning bay. (21) Engine support

beams. (22) Inner starboard engine. (23) Thrust reverser (on inner engines only). (24) Outer starboard Rolls-Royce *Conway* by-pass turbo-jet engine. (25) Noise suppressors. (26) Hydro-electric rudder actuators - in three sections. (27) Hydro-electric elevator actuators - in two sections. (28) Jack for altering the angle (incidence) of the tail-plane. (29) Port engines. (30) Two-section ailerons. (31) Flaps, shown down (but only used for take-off or landing purposes). (32) Air brakes, shown up. (33) Wing slats.

WING SLATS

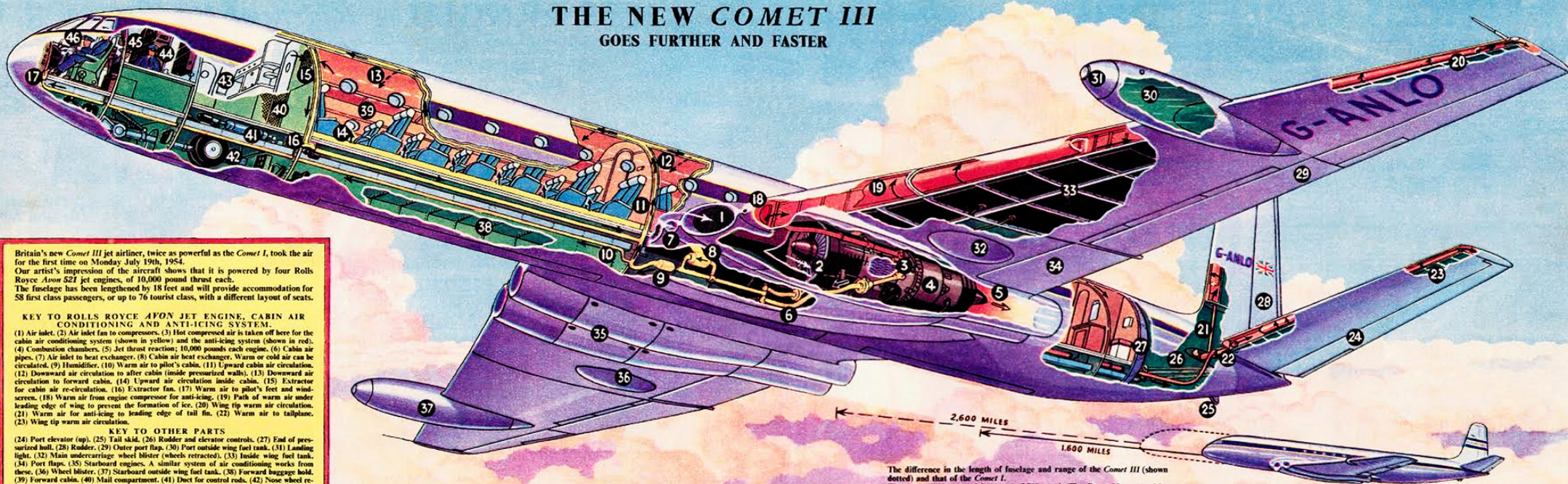
When the aircraft reaches low stalling speed, the air flow over wings is broken up, so the slats are opened and air flow restored. This makes for low landing speeds.

RECOGNITION FEATURES

Length, 158 ft. 10 ins.
Span, 140 ft.
Height (on ground), 39 ft. 1½ ins.

THE NEW COMET III

GOES FURTHER AND FASTER



Britain's new *Comet III* jet airliner, twice as powerful as the *Comet I*, took the air for the first time on Monday July 19th, 1954. Our artist's impression of the aircraft shows that it is powered by four Rolls Royce *Avon 521* jet engines, of 10,000 pound thrust each. The fuselage has been lengthened by 18 feet and will provide accommodation for 58 first class passengers, or up to 76 tourist class, with a different layout of seats.

KEY TO ROLLS ROYCE AVON JET ENGINE, CABIN AIR CONDITIONING AND ANTI-ICING SYSTEM.

(1) Air inlet. (2) Air inlet fan to compressors. (3) Hot compressed air is taken off here for the cabin air conditioning system (shown in yellow) and the anti-icing system (shown in red). (4) Combustion chambers. (5) Jet thrust reaction; 10,000 pounds each engine. (6) Cabin air pipes. (7) Air inlet to heat exchanger. (8) Cabin air heat exchanger. Warm or cold air can be circulated. (9) Humidifier. (10) Warm air to pilot's cabin. (11) Upward cabin air circulation. (12) Downward air circulation to after cabin (inside pressurized walls). (13) Downward air circulation to forward cabin. (14) Upward air circulation inside cabin. (15) Extractor for cabin air re-circulation. (16) Extractor fan. (17) Warm air to pilot's feet and wind-screen. (18) Warm air from engine compressor for anti-icing. (19) Path of warm air under leading edge of wing to prevent the formation of ice. (20) Wing tip warm air circulation. (21) Warm air for anti-icing to leading edge of tail fin. (22) Warm air to tailplane. (23) Wing tip warm air circulation.

KEY TO OTHER PARTS

(24) Port elevator (up). (25) Tail skid. (26) Rudder and elevator controls. (27) End of pressurized hull. (28) Rudder. (29) Outer port flap. (30) Port outside wing fuel tank. (31) Landing light. (32) Main undercarriage wheel blister (wheels retracted). (33) Inside wing fuel tank. (34) Port flaps. (35) Starboard engines. A similar system of air conditioning works from these. (36) Wheel blister. (37) Starboard outside wing fuel tank. (38) Forward baggage hold. (39) Forward cabin. (40) Mail compartment. (41) Duct for control rods. (42) Nose wheel retracted. (43) Galley or kitchen. (44) Navigator. (45) Radio operator (Flight engineer behind him). (46) Captain and co-pilot.

The difference in the length of fuselage and range of the *Comet III* (shown dotted) and that of the *Comet I*. The *Comet III* has a cruising speed of 500 m.p.h. The *Comet I* is powered by four De Havilland *Ghost* jet engines of 5,000 pounds thrust each and has a cruising speed of 490 m.p.h.

THE WESTLAND WIDGEON AND LONDON'S NEW HELIPORT

The *Widgeon* is a five-seater helicopter of modern design for passenger service — four passengers and pilot — but it can easily be adapted for ambulance work. Then it carries two stretchers, one above the other, on the port side, and medical attendant and pilot on the starboard side. The aircraft can also be adapted to carry half a ton of freight. The engine is a vertically placed Alvis *Leonides* nine-cylinder radial of 515 h.p., driving the rotor blades through a vertical shaft and epicyclic gearbox. Top speed is 109 m.p.h. and cruising speed 80 m.p.h. The rate of climb is 600 ft. per minute. Range is 310 miles. Westland Aircraft have been given permission to build a Heliport for London on the South bank of the River Thames near Battersea. Our artist's impression of how it will look when completed, at the end of the year, is shown on the right.

KEY TO HOW IT FLIES: (1) Cyclic-pitch control column. This controls forward, backward and sideways flight by tilting the rotor head. (2) Collective-pitch control column. This controls vertical flight by varying the pitch of the rotor blades. (3) Rudder pedals. These alter the pitch of the tail rotor blades to swing the tail one way or the other, like a rudder. (4) Instrument panel and engine controls. (5) Control linkages. (6) Collective-pitch control arm. (7) Cyclic-pitch control arms. (8) Cyclic-pitch rotor head tilt arms. (9) Collective-pitch rotor blade arms. (10) Rotor blades; 49 ft. 2 in. diameter. (11) Cooling-air ducts for engine. (12) Cooling-air duct for gearbox. (13) Two-stage epicyclic gearbox for rotor and tail rotor drives. (14) Vertical driving shaft. (15) Drive shaft for tail rotor. (16) Engine cooling fan.

(17) Cooling air passes over the cylinders. (18) Alvis *Leonides* 515 h.p. nine-cylinder radial engine and clutch. (19) Exhaust outlet. (20) Engine cooling-air outlet (both sides of fuselage). (21) Gearbox of tail rotor drive. (22) Hydraulic pump drive. (23) Tail rotor drive shaft and rotor pitch cables. (24) Tail rotor gearbox. (25) Tail rotor blades.

KEY TO OTHER PARTS: (26) Pneumatic shock-absorbing legs for main undercarriage. (27) Rear fuel tank; 41½ gallons. (28) Front fuel tank; 41½ gallons. (29) Port navigation light. (30) Underslung freight-carrying bracket. (31) Swivelling nose-wheel. (32) Sliding entrance door. (33) Five-seater cabin. (34) Air-speed indicator head.

KEY TO LONDON'S NEW HELIPORT TO BE BUILT ON THE SOUTH BANK OF THE RIVER THAMES: (A) Take-off and landing area. (B) Control room. (C) Passengers' waiting-room. (D) Loading area. (E) Freight shed and workshops. (F) Approach road from Lombard Road, Battersea. (G) Car Park. (H) Boat landing-stage at low tide. The river is shown at low tide.

Meeting the needs of industry as a means of hauling loads, particularly where loading and unloading have to be carried out in confined spaces, is this unique vehicle, the 'Shorland 20'. One of the wide range of Conveyancer mechanical handling vehicles, it is manufactured by Short Brothers and Harland Ltd. It is termed a 'Straddle Carrier' because, unlike conventional methods of transport, this vehicle carries its load by straddling it and transporting it clutched beneath the superstructure.

Diesel-powered and chain-driven to both rear wheels, the 'Shorland 20' employs four-wheel steering which, when loaded, gives the vehicle an inside radius of just over 10 ft., despite its overall length of 15 ft. 6 ins. Alternatively, the rear-wheel steering may be locked and the vehicle steered by the conventional method, using the front wheels only.

Operated single-handed, the straddle carrier is driven over its load. To facilitate handling, this is stored on either a bolster or pallet (depending on the nature of the load), which is clamped and hoisted by hydraulic power. The load is then transported to its destination at a maximum speed of 30 m.p.h. Normal working loads up to 40 feet long, with a total weight of 20,000 lb., can be transported by this method, but loads of up to 100 feet in length have been successfully carried by the 'Shorland 20'.

Straddle carriers have proved particularly useful in timber yards, where long and bulky loads are in order. They are also employed with equal success in factories, brickyards and at docksides, handling loads ranging from bulky machinery and transformers, to loads made up of pipes, paper rolls or oil drums.

KEY TO NUMBERED PARTS

(1) Welded steel box-section chassis side members. (2) Front cross-member, containing 16-gallon hydraulic oil reservoir. (3) Rear cross-member, forming fuel tank. (4) Instrument panel. (5) Power unit—Perkins P.6 Diesel engine developing 72 b.h.p. at 2,000 r.p.m., providing

hydraulic and mechanical power. (6) Three-speed (forward and reverse) gearbox which, combined with the Eaton two-speed differential unit (7), provides six speeds in either direction. (8) Hand-brake lever, operating transmission brake (9). (10) Tubular half-shafts, balanced to allow for steering movement. (11) Hardy Spicer universal couplings. (12) Drive sprocket. (13) 1½-in. pitch driving chain. (14) Driven chain wheel. (15) Eccentric hub for adjusting chain tension. (16) Chain guard. (17) Open-sided cast-steel forks employed on each of the four wheels. (18) Enclosed coil-spring suspension. (19) Marles integral power-assisted steering unit. (20) Rear-wheel steering locking lever. (21) Rear-wheel steering linkage. (22) Front-wheel steering linkage. (23) Flexible hydraulic hose operating expanding brakes within brake drums (24). (25) Battery box containing two six-volt batteries. (26) Combined head- and side-lights. (27) Rear- and brake-warning lights. (28) Fabricated welded-steel lifting hook, working up and down the swing-pipe (29) on guide rollers (30). (31) Swing-pipe bracing rods. The swing-pipe is pivoted (32) and operated by the hydraulic double-acting clamp cylinder (33) (see inset diagrams). (34) Lifting tubes, for raising the lifting hooks, are interconnected by the lifting linkage (35) and cross shafts (36), and operated by the hydraulic hoist cylinder (37). Clamping and lifting are controlled by hydraulic control valves (38). (39) Pallet on which the load is stored for transport.

INSET DIAGRAMS

Figure (I) shows the load (A) on its pallet (B) with clamps (C) in position to engage the pallet. In Figure II, the pallet is gripped by the expanding action of the clamp cylinder (D), pivoting the swing pipes (E) about the pivots (F). Figure III shows how hydraulics are employed in the clamping and lifting actions. Oil at high pressure introduced into the cylinder (G) through the inlet (H) forces the piston (I) outwards to produce an 'expanding' action. Conversely, oil introduced into inlet (J) causes a contracting action. By this method, oil at high pressure is converted into the mechanical effort required to clamp and hoist extremely heavy loads.

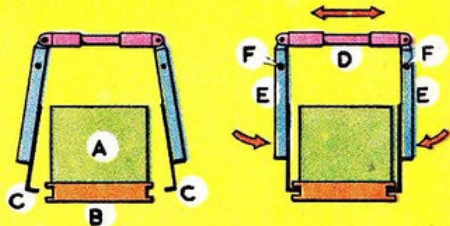


Fig. I. Fig. II.

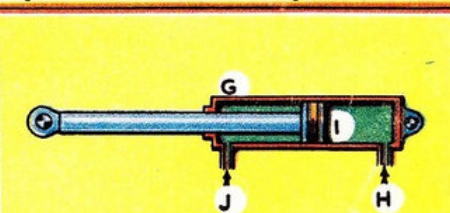
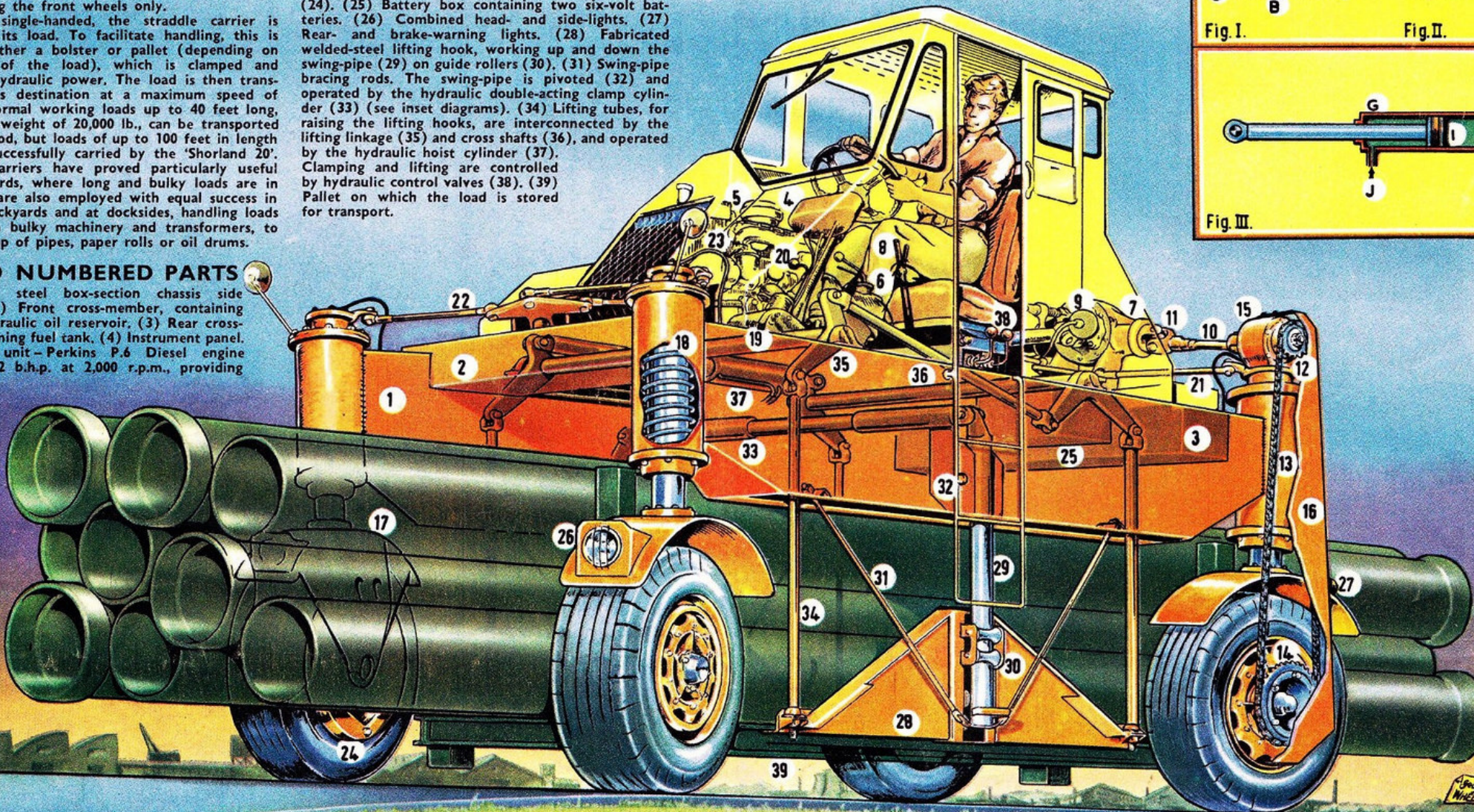


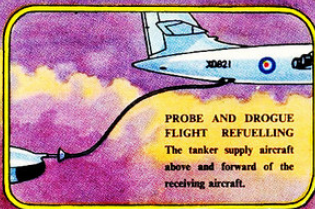
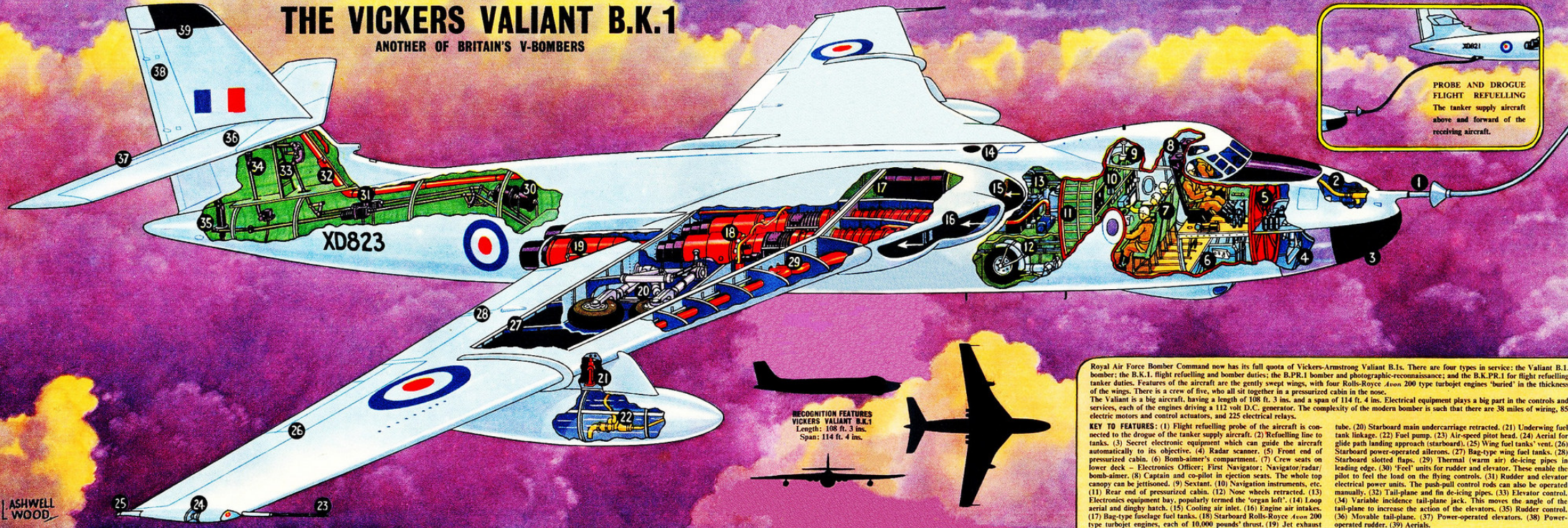
Fig. III.



The 'SHORLAND 20'

THE VICKERS VALIANT B.K.1

ANOTHER OF BRITAIN'S V-BOMBERS



RECOGNITION FEATURES
VICKERS VALIANT B.K.1
Length: 108 ft. 3 ins.
Span: 114 ft. 4 ins.

Royal Air Force Bomber Command now has its full quota of Vickers-Armstrong Valiant B.1s. There are four types in service: the Valiant B.1 bomber; the B.K.1. flight refuelling and bomber duties; the B.P.R.1 bomber and photographic-reconnaissance; and the B.K.P.R.1 for flight refuelling tanker duties. Features of the aircraft are the gently swept wings, with four Rolls-Royce Avon 200 type turbojet engines 'buried' in the thickness of the wings. There is a crew of five, who all sit together in a pressurized cabin in the nose.

The Valiant is a big aircraft, having a length of 108 ft. 3 ins. and a span of 114 ft. 4 ins. Electrical equipment plays a big part in the controls and services, each of the engines driving a 112 volt D.C. generator. The complexity of the modern bomber is such that there are 38 miles of wiring, 85 electric motors and control actuators, and 225 electrical relays.

KEY TO FEATURES: (1) Flight refuelling probe of the aircraft is connected to the drogue of the tanker supply aircraft. (2) Refuelling line to tanks. (3) Secret electronic equipment which can guide the aircraft automatically to its objective. (4) Radar scanner. (5) Front end of pressurized cabin. (6) Bomb-aimer's compartment. (7) Crew seats on lower deck - Electronics Officer; First Navigator; Navigator/radar/bomb-aimer. (8) Captain and co-pilot in ejection seats. The whole top canopy can be jettisoned. (9) Sextant. (10) Navigation instruments, etc. (11) Rear end of pressurized cabin. (12) Nose wheels retracted. (13) Electronics equipment bay, popularly termed the 'organ loft'. (14) Loop aerial and dinghy hatch. (15) Cooling air inlet. (16) Engine air intakes. (17) Bag-type fuselage fuel tanks. (18) Starboard Rolls-Royce Avon 200 type turbojet engines, each of 10,000 pounds' thrust. (19) Jet exhaust tube. (20) Starboard main undercarriage retracted. (21) Underwing fuel tank linkage. (22) Fuel pump. (23) Air-speed pitot head. (24) Aerial for glide path landing approach (starboard). (25) Wing fuel tanks' vent. (26) Starboard power-operated ailerons. (27) Bag-type wing fuel tanks. (28) Starboard slotted flaps. (29) Thermal (warm air) de-icing pipes in leading edge. (30) 'Feel' units for rudder and elevator. These enable the pilot to feel the load on the flying controls. (31) Rudder and elevator electrical power units. The push-pull control rods can also be operated manually. (32) Tail-plane and fin de-icing pipes. (33) Elevator control. (34) Variable incidence tail-plane jack. This moves the angle of the tail-plane to increase the action of the elevators. (35) Rudder control. (36) Movable tail-plane. (37) Power-operated elevators. (38) Power-operated rudder. (39) Aerials.

THE LATEST VAMPIRE JET TRAINER

(FOR YOUNG PILOTS)

Of the numerous versions of the de Havilland *Vampire* the latest is the modified T.11, which has been ordered in large quantities for the R.A.F.

A new pilot, when he arrives at the jet training centre, will have done about 50 hours flying with piston engined aircraft, so his next step is to get some ground training to familiarize him with jet controls, after which he starts the actual flying.

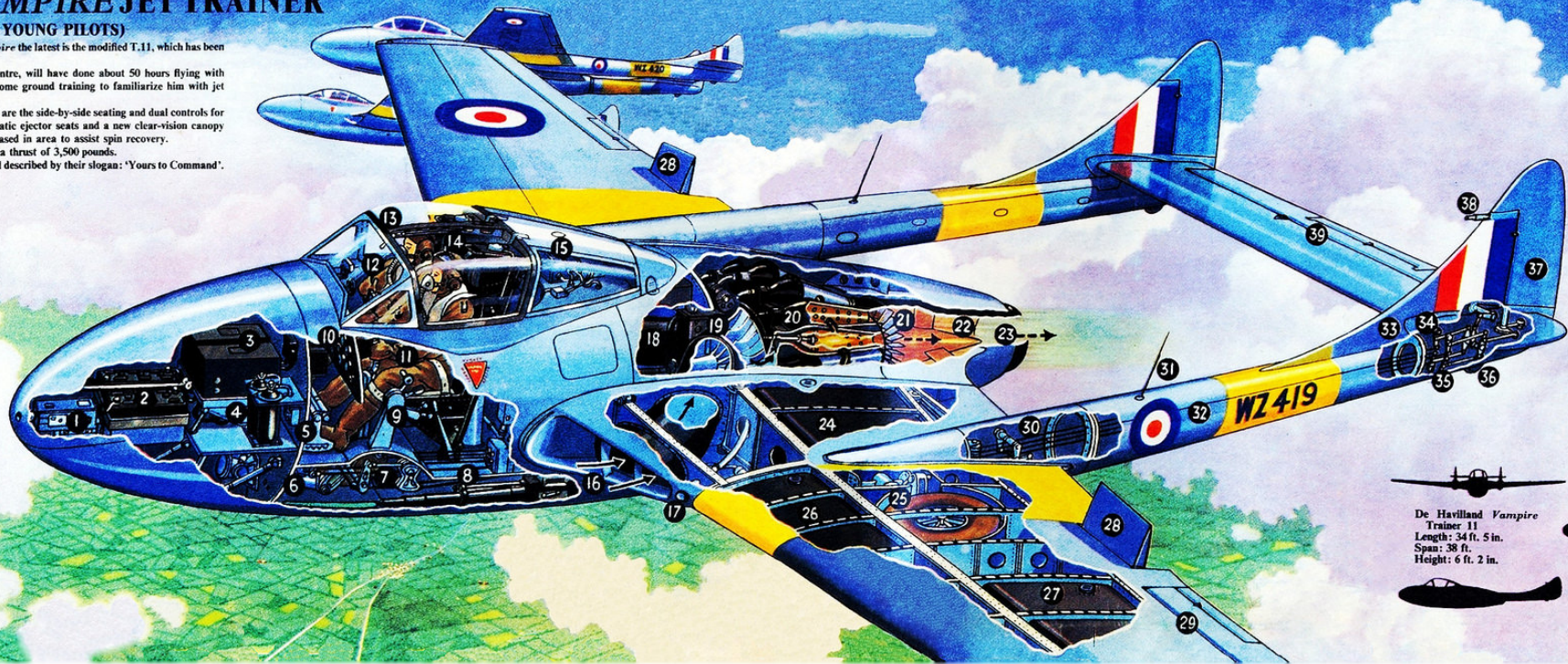
The special features of the modified *Vampire* T.11 are the side-by-side seating and dual controls for instructor and pupil, the Martin-Baker fully automatic ejector seats and a new clear-vision canopy which opens upwards. The tail fins have been increased in area to assist spin recovery.

The jet engine is the de Havilland *Goblin* 35 with a thrust of 3,500 pounds.

Flying training with the R.A.F. is indeed a thrill, well described by their slogan: 'Yours to Command'.

KEY TO PARTS

- (1) Gas-operated camera gun. (2) Batteries. (3) Radio. (4) Oxygen bottles. (5) Adjustable rudder bars. (6) Nose-wheel retracted. (7) Rudder, aileron and elevator controls. (8) 20 m.m. cannon for practice firing (one either side). (9) Throttle controls. (10) Instrument panel. (11) Pupil at control column. All the controls are duplicated on the instructor's side. (12) Instructor. (13) Quick-release clear-view canopy. (14) Martin-Baker fully automatic ejector seats. (15) Hydraulic reservoir. (16) Port air intakes to *Goblin* 35 jet engine. (17) Cooling air intake to engine auxiliaries. (18) Starboard air intake. (19) Air impeller vanes. (20) Combustion chambers and flame tubes. Here the compressed air is mixed with fuel and ignited. (21) Turbine wheel, which is driven round by the hot expanding gases and drives the impeller through a central shaft. (22) Jet tube. (23) Jet thrust of 3,500 pounds. (24) Inner port wing fuel tanks (kerosene). (25) Port undercarriage wheel retracted. (26)-(27) Outer port wing fuel tanks (kerosene). (28)-(28) Air brakes. (29) Port aileron and balance tab. (30) Rudder and elevator cables. (31) Radio aerials. (32) Port tail boom. (33) Increased fin area. (34) Elevator controls. (35) Rudder controls. (36) Tail bumpers or skid pads. (37) Port rudder. (38) Air speed indicator tube. (39) Elevator and trim tab.



De Havilland *Vampire*
Trainer 11
Length: 34 ft. 5 in.
Span: 38 ft.
Height: 6 ft. 2 in.

BRITAIN'S NEW SUPERSONIC JET FIGHTER

(THE ENGLISH ELECTRIC P.1B)

In this special drawing of the latest supersonic jet fighter, only those parts and details are shown that are permitted by security regulations.

The English Electric P.1B all-weather day and night fighter has been ordered for quantity production for the R.A.F., and is destined to follow present-day fighters into squadron service. It may be the last of the piloted fighters to go into production because of the advance in ground-to-air guided missiles as interceptors. The P.1B is powered by two Rolls-Royce Avon jet engines of a new type, one above the other in the fuselage. Its extensive armament includes air-to-air guided missiles. Performance figures are secret.

KEY TO THE POWER INSTALLATION:

(1) Air intakes to engines all round centre cone of nose. (2) Air duct to upper and lower engines. (3) Lower Rolls-Royce Avon jet engine with afterburners. (4) Engine starter. (5) Sixteen stage air compressor. (6) Annular combustion chamber. (7) Three stage turbine. (8) Upper Rolls-Royce Avon jet engine with afterburners. (9) Upper engine jet pipe to afterburner. (10) Upper engine afterburner. Here the expanding exhaust gases from the engine are again ignited, giving extra thrust. (11) Lower engine jet pipe to afterburner. (12) Lower engine afterburner. (13) Lower jet exhaust pipe. (14) Upper jet exhaust pipe.

KEY TO OTHER PARTS:

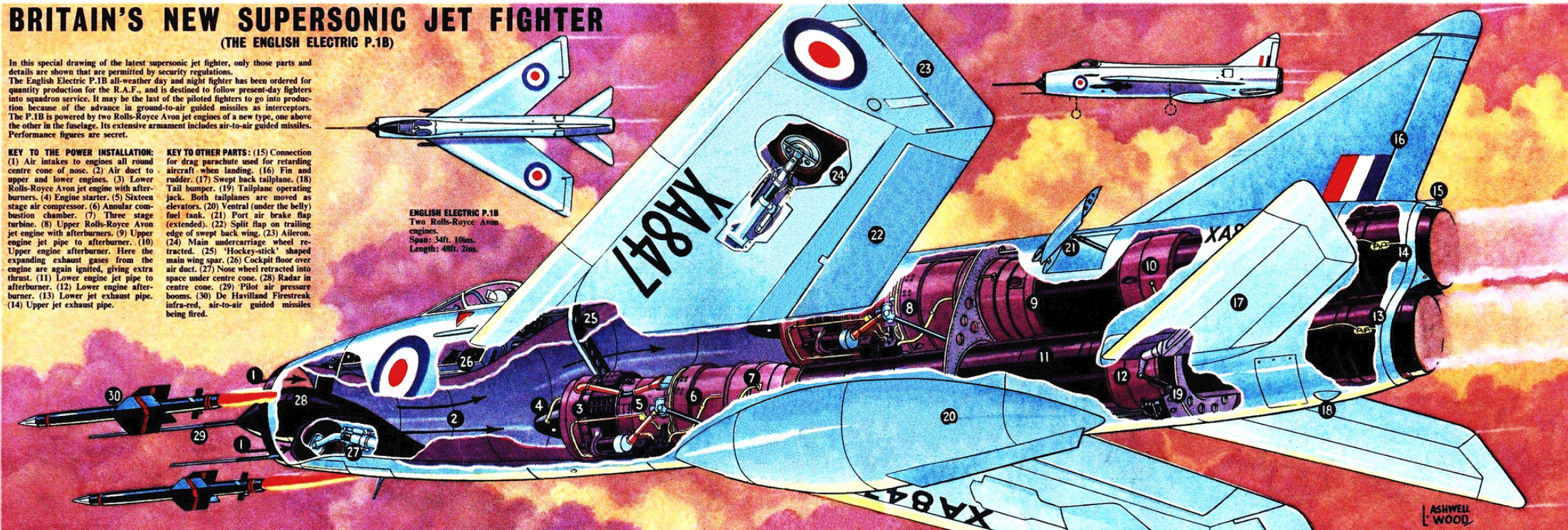
(15) Connection for drag parachute used for retarding aircraft when landing. (16) Fin and rudder. (17) Swept back tailplane. (18) Tail bumper. (19) Tailplane operating jack. Both tailplanes are moved as elevators. (20) Ventral (under the belly) fuel tank. (21) Port air brake flap (extended). (22) Split flap on trailing edge of swept back wing. (23) Aileron. (24) Main undercarriage wheel retracted. (25) 'Hockey-stick' shaped main wing spar. (26) Cockpit floor over air duct. (27) Nose wheel retracted into space under centre cone. (28) Radar in centre cone. (29) Pilot air pressure booms. (30) De Havilland Firestreak infra-red, air-to-air guided missiles being fired.

ENGLISH ELECTRIC P.1B

Two Rolls-Royce Avon engines.

Span: 34ft. 10ins.

Length: 48ft. 2ins.



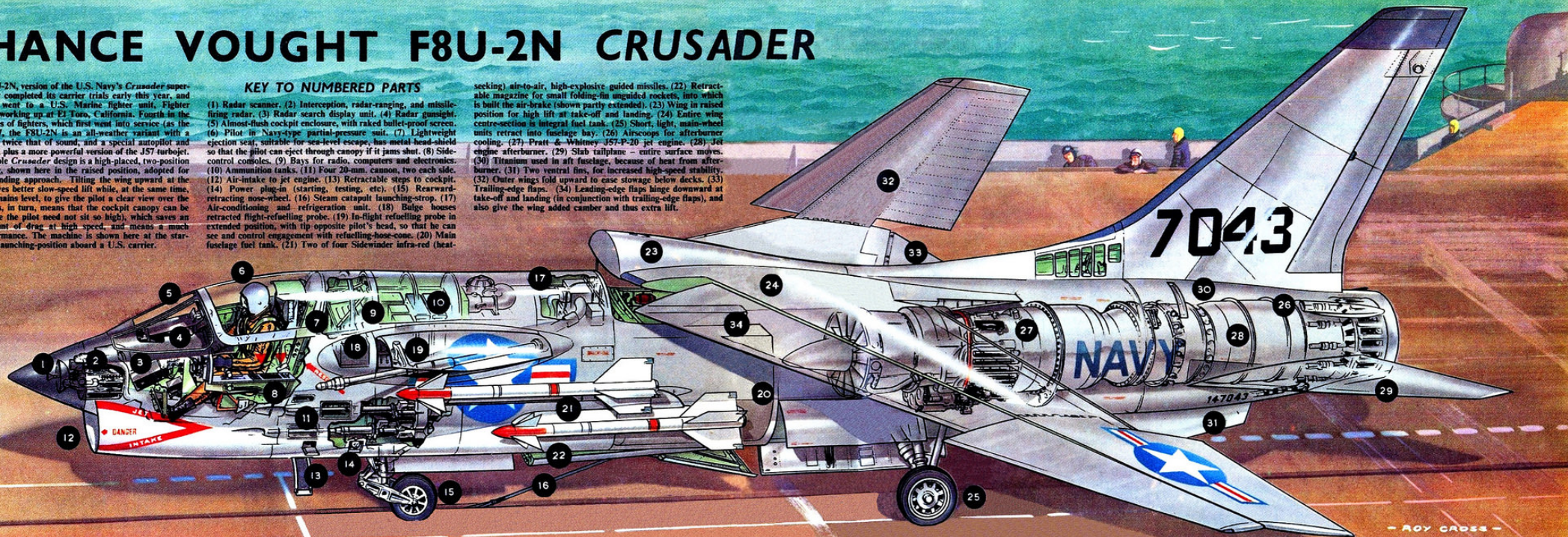
CHANCE VOUGHT F8U-2N CRUSADER

The latest, F8U-2N, version of the U.S. Navy's *Crusader* supersonic jet-fighter completed its carrier trials early this year, and first deliveries went to a U.S. Marine fighter unit, Fighter Squadron 334, working up at El Toro, California. Fourth in the *Crusader* series of fighters, which first went into service (as the F8U-1) in 1957, the F8U-2N is an all-weather variant with a speed of nearly twice that of sound, and a special autopilot and improved radar, plus a more powerful version of the J57 turbojet. Basis of the whole *Crusader* design is a high-placed, two-position sweptback wing, shown here in the raised position, adopted for take-off and landing approach. Tilting the wing upward at the leading edge gives better slow-speed lift while, at the same time, the fuselage remains level, to give the pilot a clear view over the short nose. This, in turn, means that the cockpit canopy can be smaller (because the pilot need not sit so high), which saves an enormous amount of drag at high speed, and means a much improved performance. The machine is shown here at the starboard catapult launching-position aboard a U.S. carrier.

KEY TO NUMBERED PARTS

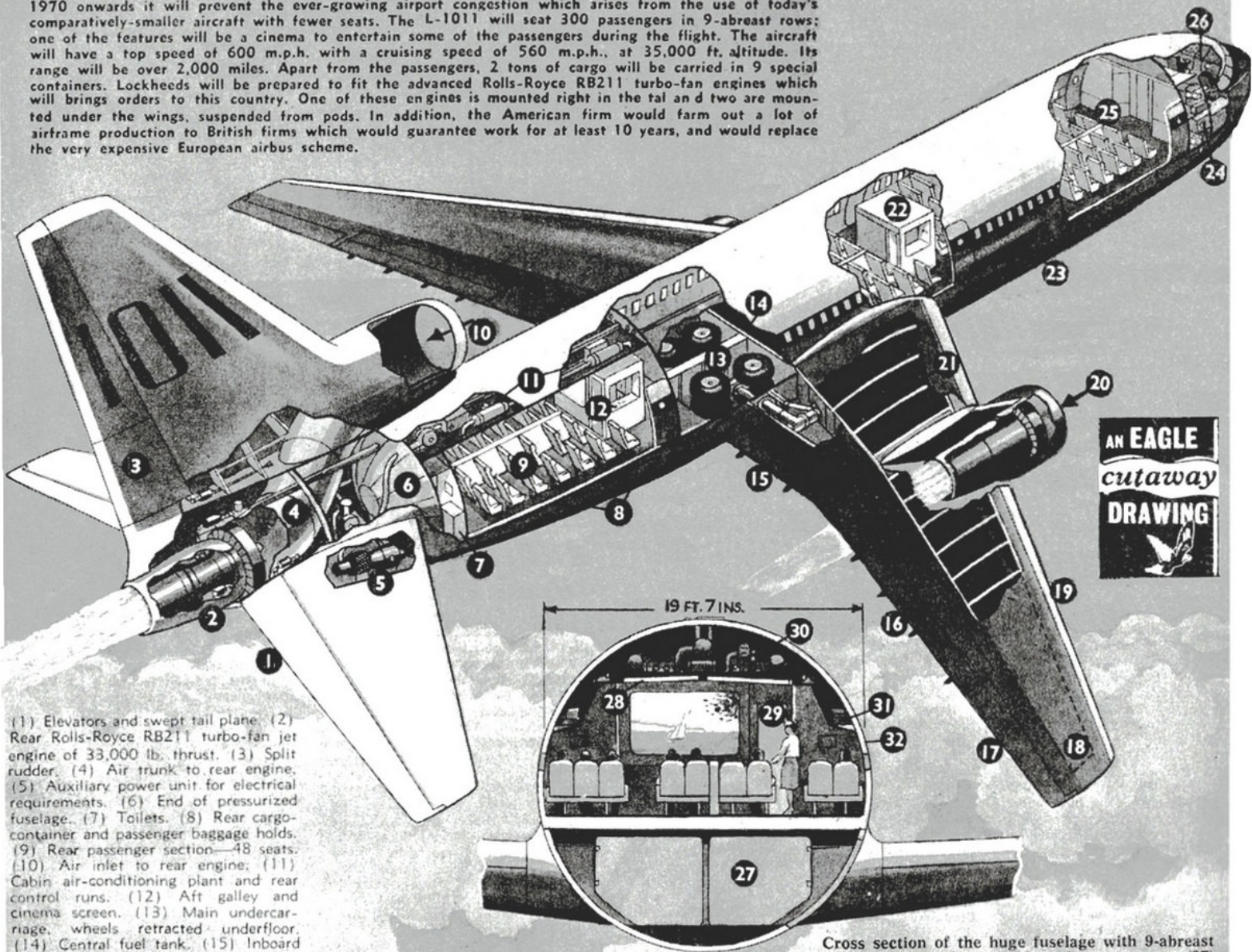
(1) Radar scanner. (2) Interception, radar-ranging, and missile-firing radar. (3) Radar search display unit. (4) Radar gunsight. (5) Almost-flush cockpit enclosure, with raked bullet-proof screen. (6) Pilot in Navy-type partial-pressure suit. (7) Lightweight ejection seat, suitable for sea-level escape, has metal head-shield so that the pilot can eject through canopy if it jams shut. (8) Side-control consoles. (9) Bays for radio, computers and electronics. (10) Ammunition tanks. (11) Four 20-mm. cannon, two each side. (12) Air-intake to jet engine. (13) Retractable steps to cockpit. (14) Power plug-in (starting, testing, etc.). (15) Rearward-retracting nose-wheel. (16) Steam catapult launching-stop. (17) Air-conditioning and refrigeration unit. (18) Bulge houses retracted flight-refuelling probe. (19) In-flight refuelling probe in extended position, with tip opposite pilot's head, so that he can see and control engagement with refuelling-hose-cone. (20) Main fuselage fuel tank. (21) Two of four Sidewinder infra-red (heat-

seeking) air-to-air, high-explosive guided missiles. (22) Retractable magazine for small folding-fin unguided rockets, into which is built the air-brake (shown partly extended). (23) Wing in raised position for high lift at take-off and landing. (24) Entire wing centre-section is integral fuel tank. (25) Short, light, main-wheel units retract into fuselage bay. (26) Airscoops for afterburner cooling. (27) Pratt & Whitney J57-P-20 jet engine. (28) Jet engine afterburner. (29) Slab tailplane - entire surface moves. (30) Titanium used in aft fuselage, because of heat from afterburner. (31) Two ventral fins, for increased high-speed stability. (32) Outer wings fold upward to ease stowage below decks. (33) Trailing-edge flaps. (34) Leading-edge flaps hinge downward at take-off and landing (in conjunction with trailing-edge flaps), and also give the wing added camber and thus extra lift.



CINEMA IN THE CLOUDS

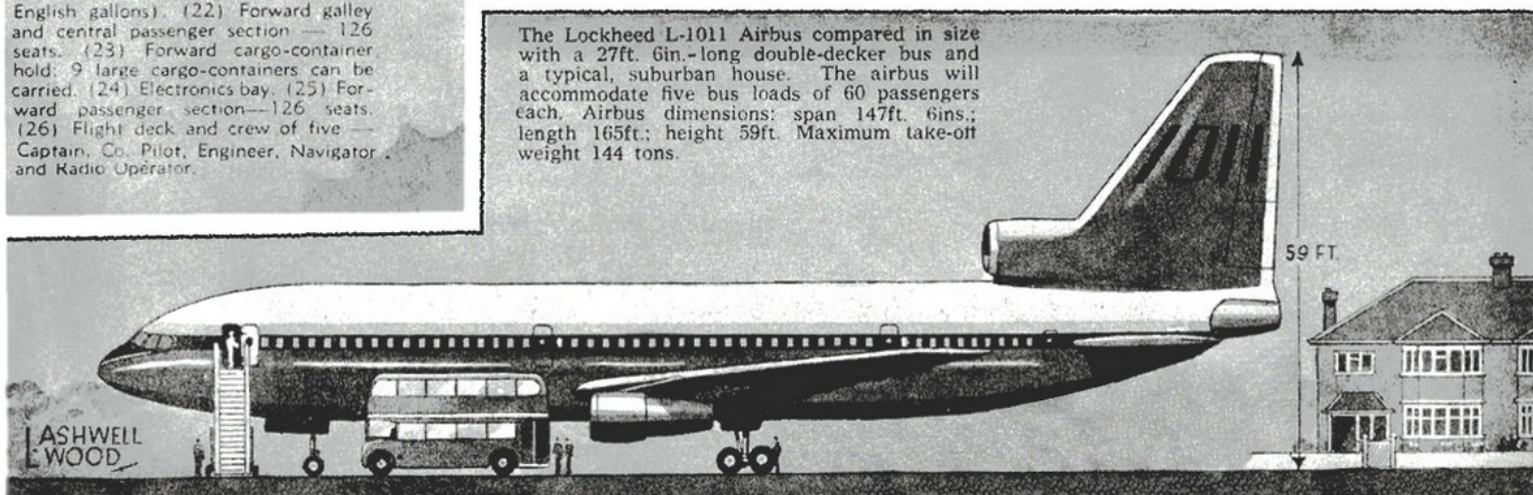
Orders for the American Lockheed airbus are on the books and plans are going ahead for the first prototype to fly in 1970. Known as the L-1011, this aircraft will be the rival to the proposed Anglo-French-German airbus over which much argument is going on. The idea of the 300-seater airbus is that from 1970 onwards it will prevent the ever-growing airport congestion which arises from the use of today's comparatively smaller aircraft with fewer seats. The L-1011 will seat 300 passengers in 9-abreast rows; one of the features will be a cinema to entertain some of the passengers during the flight. The aircraft will have a top speed of 600 m.p.h. with a cruising speed of 560 m.p.h., at 35,000 ft. altitude. Its range will be over 2,000 miles. Apart from the passengers, 2 tons of cargo will be carried in 9 special containers. Lockheeds will be prepared to fit the advanced Rolls-Royce RB211 turbo-fan engines which will bring orders to this country. One of these engines is mounted right in the tail and two are mounted under the wings, suspended from pods. In addition, the American firm would farm out a lot of airframe production to British firms which would guarantee work for at least 10 years, and would replace the very expensive European airbus scheme.



(1) Elevators and swept tail plane. (2) Rear Rolls-Royce RB211 turbo-fan jet engine of 33,000 lb. thrust. (3) Split rudder. (4) Air trunk to rear engine. (5) Auxiliary power unit for electrical requirements. (6) End of pressurized fuselage. (7) Toilets. (8) Rear cargo-container and passenger baggage holds. (9) Rear passenger section—48 seats. (10) Air inlet to rear engine. (11) Cabin air-conditioning plant and rear control runs. (12) Aft galley and cinema screen. (13) Main undercarriage wheels retracted underfloor. (14) Central fuel tank. (15) Inboard slotted flaps—for take-off and landing. (16) Outboard flaps. (17) Ailerons. (18) Limit of wing fuel tanks. (19) Leading edge slats or air flow spoilers. (20) Air inlet to starboard Rolls-Royce RB211 turbo-fan jet engine. (21) Wing fuel tanks—total capacity 16,120 American gallons (13,400 English gallons). (22) Forward galley and central passenger section—126 seats. (23) Forward cargo-container hold: 9 large cargo-containers can be carried. (24) Electronics bay. (25) Forward passenger section—126 seats. (26) Flight deck and crew of five—Captain, Co. Pilot, Engineer, Navigator, and Radio Operator.

Cross section of the huge fuselage with 9-abreast seating and back projection cinema screen. (27) cargo containers, (28) fluorescent lighting, (29) galley, (30) cabin air-conditioning plant, (31) enclosed hat racks and personal handbags, (32) pressurized double skin.

The Lockheed L-1011 Airbus compared in size with a 27ft. 6in.-long double-decker bus and a typical, suburban house. The airbus will accommodate five bus loads of 60 passengers each. Airbus dimensions: span 147ft. 6ins.; length 165ft.; height 59ft. Maximum take-off weight 144 tons.



JET DRAGON D.H.125

A new British transport aircraft with rear-mounted jet engines is the little Dragon, better known as the de Havilland 125 business plane – a mini jetliner that should have a success comparable to the success of mini-cars on the road.

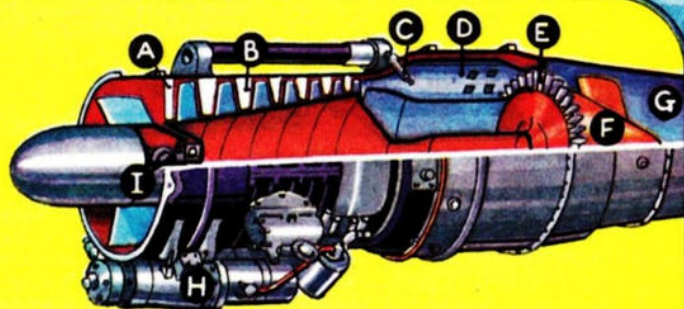
Intended to replace the famous Dove, the D.H. 125 carries up to 12 people, or six business people in luxury seating. It travels at 500 m.p.h. and can go almost anywhere, even to quite small grass airfields. Not only businessmen in a hurry will use it, for the R.A.F. have ordered 22 for navigation training.

Over 30 years of experience in the building of twin-engined light aircraft is embodied in the de Havilland 125 – a tribute to British private enterprise.

The engines are Bristol Siddeley Vipers of 3,000 pounds thrust each. Span, 47 ft.; length, 47 ft. 5 in.; height (to top of tailplane), 16 ft.

KEY TO NUMBERED PARTS

(1) Swept-back tail plane and elevators. (2) Elevator controls. (3) Swept-back rudder. (4) Rudder and elevator control runs. (5) Air-conditioning intake. (6) Toilets. (7) Coat hangers. (8) Baggage space. (9) Engine support-beam. (10) Bristol Siddeley Viper jet engine – 3,000 lb. thrust. (11) Main undercarriage retracted. (12) Undercarriage jack. (13) Air brakes extended. (14) Double-slotted flaps for take-off and landing. (15) Aileron controls. (16) Starboard aileron. (17) Fuel tanks – total capacity, 1,038 gallons. (18) Liquid de-icing edge. (19) Starboard landing light. (20) Air-conditioned cabin as fitted for six business executives. (21) Baggage. (22) Radio racks. (23) Large entrance door. (24) Small galley or buffet. (25) Control column and instrument panel. (26) Flying control linkage. (27) Nose wheels retracted. (28) Batteries. (29) Anti-collision radar.



BRISTOL SIDDELEY VIPER TURBOJET

(A) Air inlet guide vanes. (B) Axial flow air compressor. (C) Fuel burner. (D) Annular combustion chamber. (E) Single-stage turbine driving compressor. (F) Cone against which jet thrust reacts. (G) Jet exhaust pipe. (H) Fuel and oil pumps. (I) Generator.

The new jet, the 125th de Havilland design, is named Dragon in honour of the historic and unforgettable D.H.84 of 1932. This practical wooden biplane was the company's first twin-engined transport.



LORD OF THE ISLES

Lord of the Isles was a 4-2-2 locomotive of the 'Achilles' class, designed by William Dean and introduced into the Great Western Railway system in 1894.

There were eighty of these locomotives, and they were the last of the single-wheelers on the Great Western. They have often been described as being among the most handsome engines ever built. Their performance matched their elegance, and it was one of these engines, *Duke of Connaught*, which, in May, 1904, took over the train from *City of Truro* after its record-breaking run, and continued the journey to Paddington from Bristol at an average speed of over 70 m.p.h.

Lord of the Isles carried forward a name made famous by an earlier locomotive, one of Sir Daniel Gooch's 'Eight-foot Singles', a most outstanding locomotive in its day.

The glory of the 'Achilles' class was short-lived, however. Due to the demand for larger 4- and 6-coupled engines to cope with the heavier traffic, they had all disappeared by 1916. The spirit of these old single-wheelers lives on, however. Lord of the Isles is popular among the model railway fraternity, and a fine model of this class is exhibited in the Science Museum in London.

Weight of locomotive in working order, 49 tons.
Working pressure, 165 lb. sq. in.
Cylinders (two), 19 ins. in diameter, 24-in. stroke.
Overall length (locomotive and tender), 57 ft. 8½ ins.

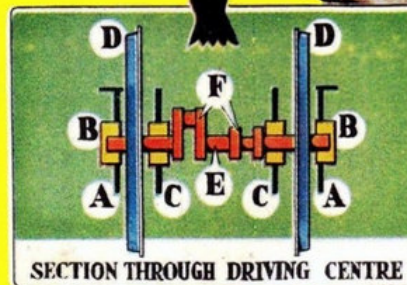


The first 'LORD of the ISLES'



KEY TO NUMBERED PARTS

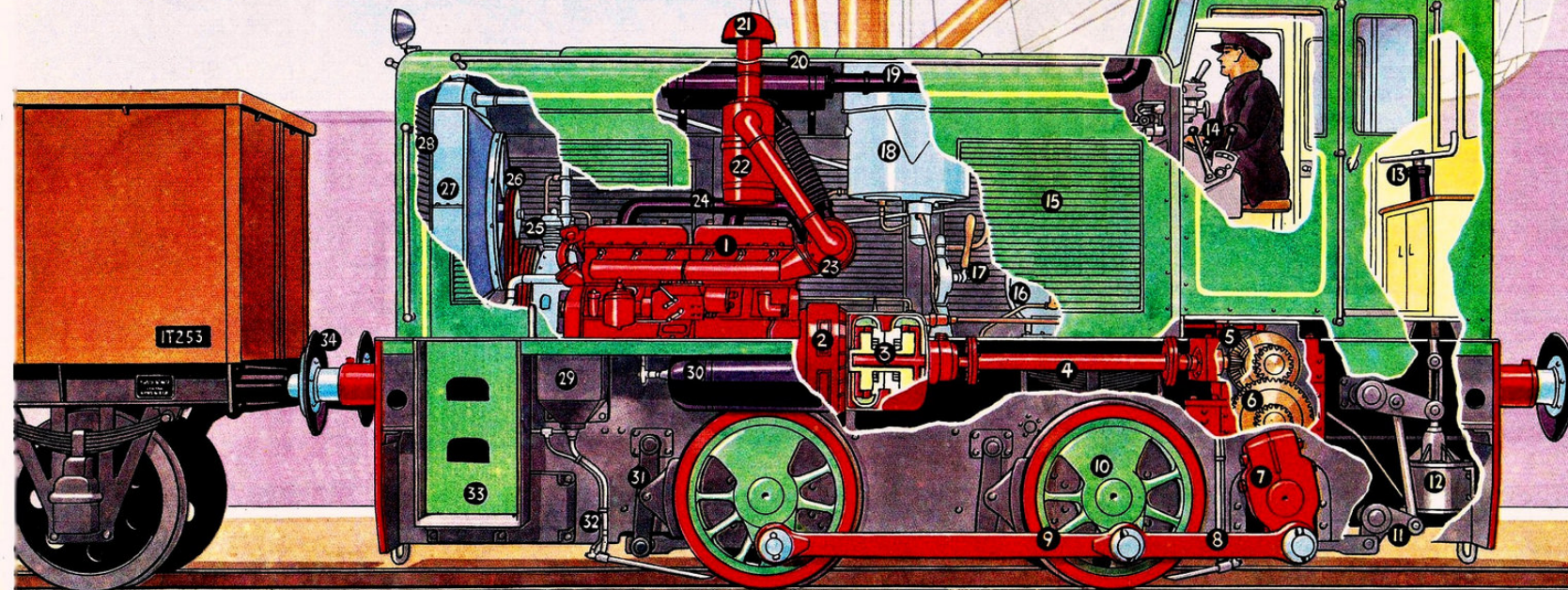
(1) Firebox. (2) Firehole. (3) Brick arch. (4) Fire tubes. (5) Smokebox. (6) Tube-plate. (7) Boiler barrel. (8) Wooden lagging. (9) Iron cladding. (10) Feed water clack-valve. (11) Salter safety valve. (12) Spring balance for safety valve (inside cab). (13) Whistles. (14) Whistle valves, pressure and vacuum gauges (also inside cab). (15) Regulator handle connected to (16) regulator valve inside the steam dome (17). (18) Main steam-pipe feeding the two inside cylinders (19). (20) Spark arrester plate. (21) Blast pipe, carrying exhaust steam up through the copper-capped chimney (22). (23) Piston. (24) Connecting rod. (25) Crankshaft. (26) Stephenson's valve-gear working slide valves (27), and controlled by the reversing screw in the cab (28). (29) 7 ft. 9 in.-diameter driving wheels carried in axle-boxes (30) with leaf springs (31), and sandwiched between the outer frame (32) and the inner frame (33) - see 'Section through Driving Centre' diagram. (34) Splasher, bearing nameplate and crest of the Great Western Railway Company. (35) Trailing wheels, 4 ft. 7½ ins. in diameter. (36) Trailing wheel springs. (37) Brake gear acting on driving and trailing wheels, operated by brake cylinder (38). (39) Bogie with 4 ft. 1½ in.-diameter wheels. (40) Sand box. (41) Sanding pipe. (42) Vacuum-brake connection pipe. (43) Lamp irons. (44) Guard irons. (45) Standard G.W.R. 3,000-gallon tender. (46) Water tank. (47) Water-filling trap. (48) Tender brake-gear.



The 'Section through Driving Centre' diagram shows the arrangement of the wheels and axle within the double frames: (A) Outer frame. (B) Axle-box. (C) Inner frame and axle-box. (D) Driving wheels. (E) Crankshaft. (F) Cranks.

Geoffrey
WHEELER

DIESEL HYDRAULIC SHUNTER



The object of this drawing is to show, in its simplest form, the principle of Diesel hydraulic propulsion for locomotives. These sturdy 0-4-0 shunters are made by Ruston and Hornsby Ltd., Lincoln, and are of a type to be seen all over the country in docks, steel and engineering works, etc. The 156 h.p. Diesel engine drives through an hydraulic torque, or power converter, to a reverse-reduction gearbox, and from there a large crank drives the wheels. Length over buffer beams is 21 ft. 2½ ins., height 11 ft., and weight in working order 28 tons; they cost approximately £10,000 each. In a later issue, we shall show, in its simplest form, the principle of a Diesel electric shunter.

KEY TO DIESEL HYDRAULIC SYSTEM: (1) 156 h.p., six-cylinder Ruston Diesel engine. (2) Clutch for disengaging drive to gearbox. (3) Torque (or power) converter. This is the essence of the hydraulic system. By twin unit impellers and turbine wheels revolving in oil, the engine torque (or power) is stepped up or down, according to load conditions. (4) Output shaft to gearbox. (5) Bevel pinion drive to either of two crown wheels for forward or reverse drive. (6) Final reduction gear drive. (7) Driving crank. (8) Connecting rod to wheels. (9) Coupling rod. (10) Driving wheels.

KEY TO OTHER PARTS: (11) Brake-operating cranks. (12) Compressed-air brake cylinder. (13) Hand-brake. (14) Control gauges and three, simple, driver's controls; i.e. engine speed, reverse gear, and air brakes. These are duplicated either side of cab. (15) Air-grilles. (16) Brake air-reservoir. (17) Hand fuel pump, for refuelling from barrels. (18) Fuel tank - 135 gallons. (19) Exhaust pipe to cab roof. (20) Exhaust silencer. (21) Engine air-intake. (22) Oil bath air-filter. (23) Exhaust-driven air-pressure-charger to engine. (24) Exhaust pipe. (25) Engine-driven air-compressor. (26) Radiator fan. (27) Engine water-cooling radiator. (28) Radiator air-inlet. (29) Sand-box. (30) Main compressed-air reservoir, for engine starting. (31) Brake blocks. (32) Air-operated sand-gear. (33) Shunter's platform. (34) Large buffers. These are fitted in order to avoid buffer lock on sharp curves.

THE BRISTOL 192

TWIN ENGINE MILITARY HELICOPTER

Eight of these multi-purpose twin engine helicopters, the largest in Europe, are now flying, and the first R.A.F. transport squadron will be formed. They are powered by two Napier Gazelle free-turbine jet engines of 1,650 maximum equivalent horsepower each. This enables the 192 to hover or climb on one engine. The two Gazelles are mounted at either end of the main cabin, and an intermediate shaft along the top of the fuselage allows one engine to drive both rotors. The cruising speed of the helicopter is 120 knots.

The aircraft's multi-purpose duties include the transport of 18 fully-equipped troops or 12 stretcher cases, or a 2½-ton load suspended beneath the fuselage. Large fuel tanks allow a range of 680 miles.

KEY TO HOW IT WORKS: (1) Pilot head for air-speed indicator, (2) Landing light (3) Co-pilot and navigator, (4) Pilot, (5) Yaw pedals; these control the directional swing, left or right, (6) Collective pitch lever; this controls the pitch of the rotor blades for vertical flight, (7) Cyclic pitch lever; this controls the tilt of the rotor head for forwards, backwards or sideways flight, (8) Flying control ducts, (9) Air intake

to the forward Napier Gazelle free turbine jet engine, (10) Air compressor, (11) Combustion chambers, (12) Turbine wheels, (13) Jet pipes, (14) Jet exhausts, (15) Reduction gearbox, (16) Intermediate shaft drive between engines; this allows one engine to drive both rotors, (17) Intake for engine and gearbox cooling air, (18) Collective and cyclic pitch control spider, (19) Forward rotor blades, 48 ft. 6 in. in diameter, (20) Front fuel tank - 280 gallons, (21) Communicating door to main cabin, (22) Swivelling front wheels, (23) Main cabin, 24 ft. long, (24) Main door, (25) Haulage winch, (26) Seating can be arranged for 18 fully-equipped troops, (27) Intermediate shaft drive and rear rotor controls, (28) Accommodation can be made for 12 stretcher cases, (29) Escape hatch, (30) Electric panel and radio racks, (31) Intermediate fuel tank - 164 gallons, (32) Engine air-intake, (33) Rear Napier Gazelle engine, (34) Jet exhausts, (35) Engine oil tank, (36) Rear fuel tank - 116 gallons, (37) Oil cooler, (38) Generators, (39) Rear rotor controls, (40) Intake for engine and gearbox cooling air, (41) Reduction gearbox, (42) Rear rotor head, (43) Drooped tailplane, (44) Stabilizing fin, (45) Thunderbird guided-missile site.



ASHWELL
WOOD

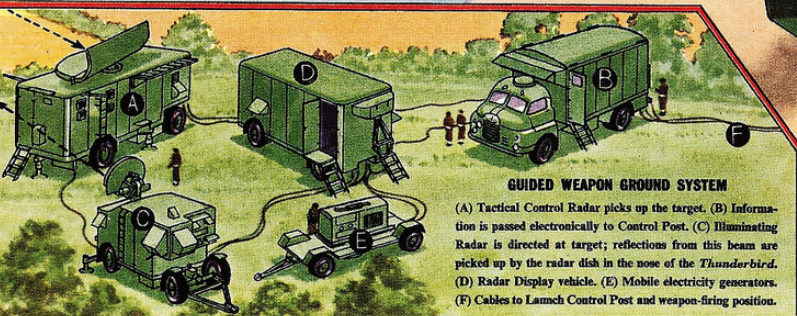
THUNDERBIRD

GUIDED WEAPON FOR THE BRITISH ARMY

The English Electric surface-to-air guided weapon *Thunderbird* is now in service with the Army's Guided Weapon Regiments. Working with its ground guiding system of mobile radar army vehicles, the *Thunderbird*, once on the track of enemy aircraft, will seek out and destroy them; it will be virtually impossible to shake it off.

Powered by solid fuel propulsion motors, the *Thunderbird* attains a speed of more than three times that of sound. It is fired and accelerated to high supersonic speed in a matter of seconds by four booster rockets. After the rockets are burnt out, they automatically fall away and the propulsion motors take over, accelerating the weapon to the fantastic speed of 2,640 m.p.h. Our defence, in which the *Thunderbird* will play an important part, must be mobile, and prepared for danger at any point and in any direction. The teaching of radar and electronics provides part of an interesting career in the Army.

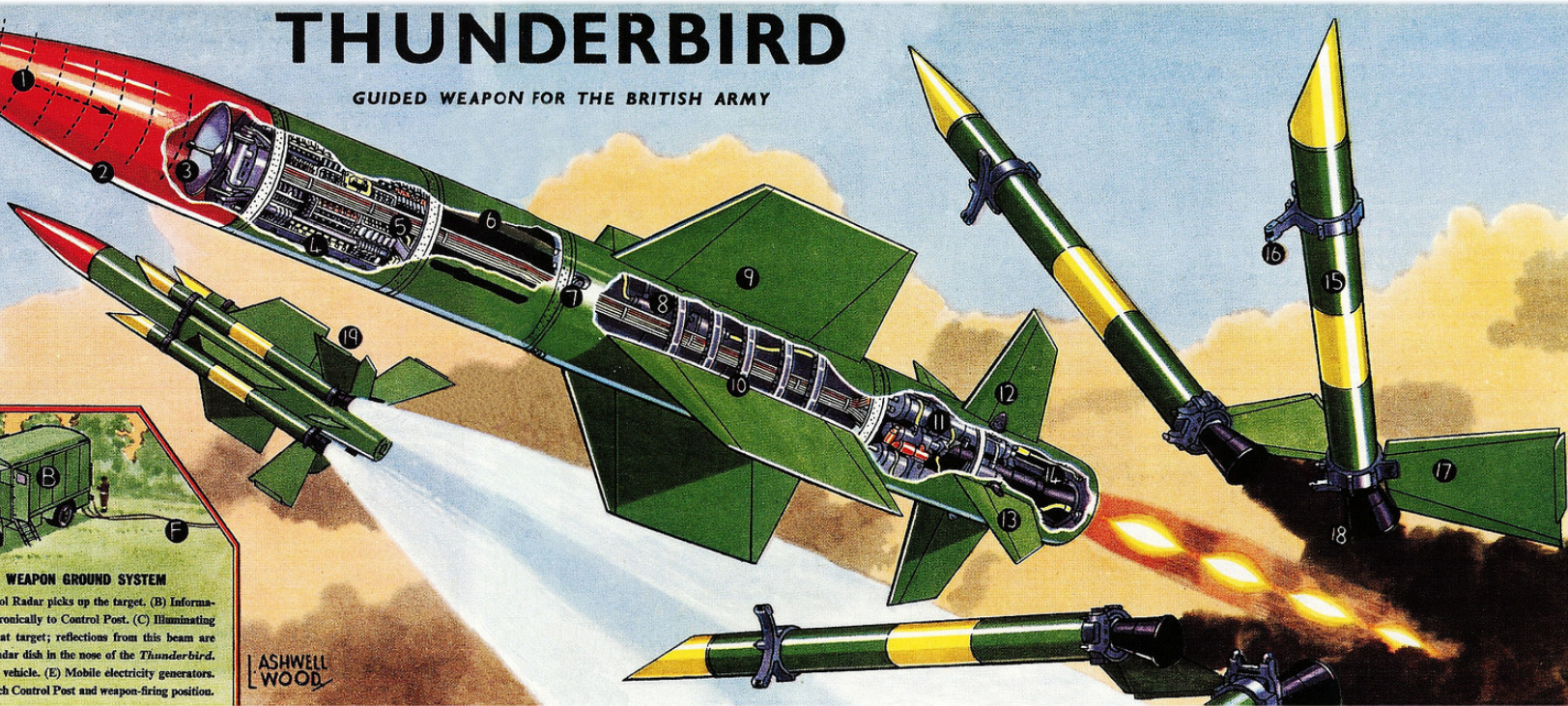
KEY TO HOW IT WORKS: (1) Radar beam reflections from target. (2) Plastic transparent nose-cap. (3) Radar dish, which picks up the target signals and passes them on to the guidance system. (4) The secret guidance and electronic control system. (5) Cable ducts to controls. (6) Explosive warhead. (7) Booster rocket attachment points. (8) Secret solid fuel propulsion motors. (9) Stabilizing wings. (10) Wing attachment frames. (11) Control generators, worked by exhaust gas from the propulsion motors. (12) Horizontal control fins (rudders). (13) Vertical control fins (elevators). (14) Motor discharge nozzle. (15) Spent booster-rockets falling away. (16) Attachment points released. (17) Stabilizing fins. (18) Discharge nozzles. (19) Complete weapon, as launched, and before booster rockets fall away.



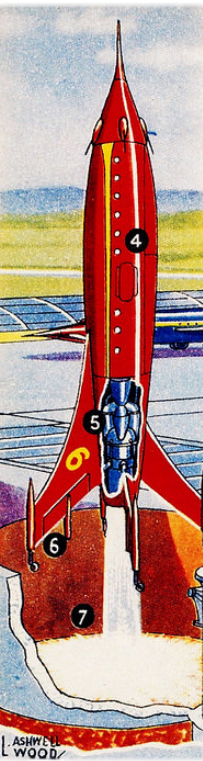
GUIDED WEAPON GROUND SYSTEM

(A) Tactical Control Radar picks up the target. (B) Information is passed electronically to Control Post. (C) Illuminating Radar is directed at target; reflections from this beam are picked up by the radar dish in the nose of the *Thunderbird*. (D) Radar Display vehicle. (E) Mobile electricity generators. (F) Cables to Launch Control Post and weapon-firing position.

ASHWELL
WOOD



A drawing of a blue and red supersonic aircraft, labeled 21, 22, and 23. The aircraft is shown in profile, flying towards the right. It has a blue body with red and yellow stripes along the fuselage. The tail fin is blue with the number 21. The nose cone is red. The aircraft is labeled with the number 22 on the fuselage and 23 on the tail fin.



THE WORLD'S FIRST JET FLYING-BOAT FIGHTER

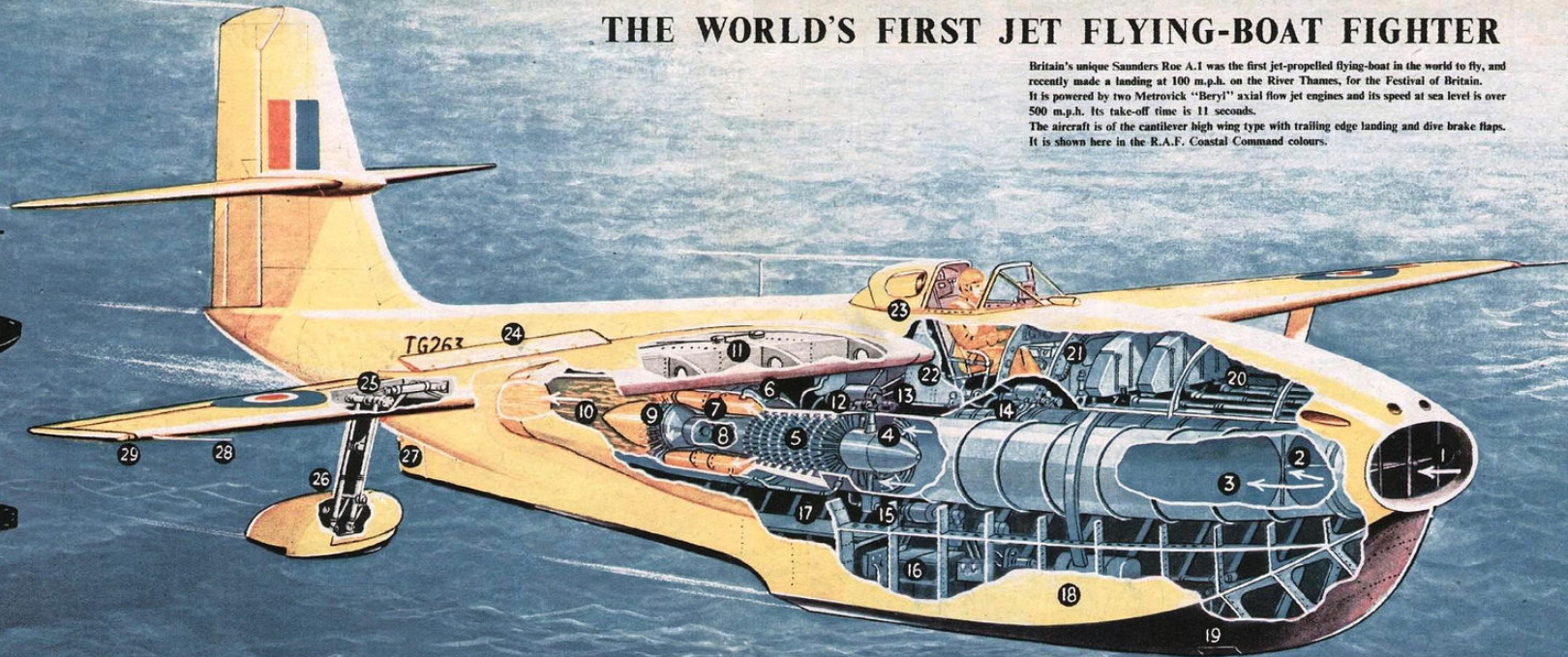
Britain's unique Saunders Roe A.1 was the first jet-propelled flying-boat in the world to fly, and recently made a landing at 100 m.p.h. on the River Thames, for the Festival of Britain. It is powered by two Metrovick "Beryl" axial flow jet engines and its speed at sea level is over 500 m.p.h. Its take-off time is 11 seconds. The aircraft is of the cantilever high wing type with trailing edge landing and dive brake flaps. It is shown here in the R.A.F. Coastal Command colours.

KEY TO HOW IT WORKS

(1) Engine air intake. (2) Air trunk to port engine. (3) Air trunk to starboard engine. (4) Air intake grill to compressor. (5) Blades of axial or straight flow air compressor. (6) Fuel pipes. (7) Combustion chambers (situated all round the central shaft) where the fuel and compressed air are mixed and ignited. (8) Hollow central shaft driving compressor. (9) Double turbine wheel, which is rotated by the hot gases and drives the compressor. (10) Jet outlet pipe. (11) Fuel tanks in wing. (12) Starting motor and auxiliaries connected to shaft of compressor. (13) Starboard engine controls. (14) Port engine. (15) Generator. (16) Batteries.

KEY TO OTHER PARTS

(17) Walkway for engine maintenance. (18) All metal hull construction. (19) Automatic mooring pick up. (20) Gun bay of four 20 mm. cannons. (21) Fireproof and waterproof bulkhead. (22) Armour-plated pilot's cockpit. (23) Sliding cockpit hood. (24) Dive brake flaps. (25) Wing float retracting gear. (26) Inward retracting and rotating float. (27) Water rudder. (28) Vane yaw meter. (29) Starboard wing tip light.



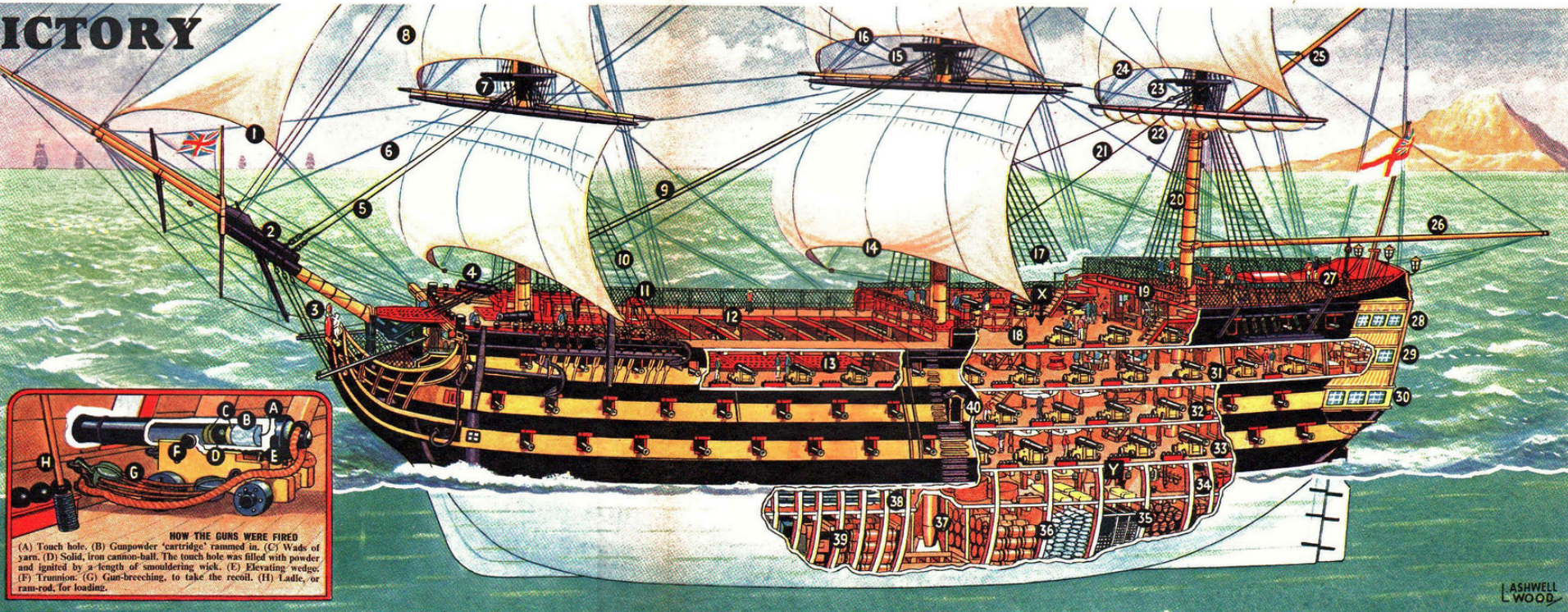
H.M.S. VICTORY

The world's most famous ship has played a noble part in the making of British naval history. H.M.S. *Victory* was the famous flagship in which Nelson won the Battle of Trafalgar. Today, restored to her Trafalgar condition, she is preserved in No. 2 dry-dock at Portsmouth. In this special EAGLE feature, we show her in correct detail, as she was immediately prior to Trafalgar - on the 21st October, 1805 - a First Rate Ship of 100 guns.

She was laid down in 1759, and launched at Chatham in 1765 - her length on the keel, 153 ft.; beam, 51½ ft.; depth of hold, 21½ ft.; tonnage, 2,162. She was built immensely strong, and 300,000 cubic feet of timber, mostly oak, went into her construction - an example of 'the wooden walls of old England'. The *Victory* was manned by 850 men, and her 100 guns were distributed as follows: Forecastle, two 68-pounder carronades, the largest in the Navy; Upper deck, thirty 12-pounders; Quarter deck, ten 12-pounders; Middle deck, twenty-eight 24-pounders; Gun deck, thirty 32-pounders. The gun-crews included 31 'powder monkeys', who were boys of from twelve to fourteen years of age.

KEY TO SPECIAL POINTS ON MAIN DRAWING: (X) Marks the spot on the Quarter deck where Nelson fell, mortally wounded. (Y) The cockpit on the Orlop deck where he died. **KEY TO ABOVE DECKS:** (1) Jib. (2) Bowsprit. (3) Figure-head. (4) Two 68-pounder carronades on the fore-castle. (5) Fore-mast stays. (6) Fore-sail. (7) Fore-top. (8) Fore-top-sail (above this a fore-topgallant sail). (9) Main-mast stays. (10) Rigging on shrouds. (11) Ship's bell. (12) The waist. (13) Main hatches. (14) Main-sail. (15) Main-top. (16) Main-top-sail (above this, a main-topgallant sail). (17) Port-side rigging, or shrouds, cut away for clearness. (18) Quarter deck; 10 guns. (19) Steering wheels. (20) Mizzen-mast. (21) Mizzen-mast stays. (22) Mizzen-sail (reefed). (23) Mizzen-top. (24) Mizzen-top-sail (above this, a mizzen-topgallant sail). (25) Spanker-gaff. (26) Spanker-hoist (these are for a spanker-sail). (27) Poop deck. The netting shown here, and elsewhere, was where the seamen stowed their hammocks, to protect them from shot and flying splinters when in action.

KEY TO BELOW DECKS: (28) Captain's cabin. (29) Nelson's cabin. (30) Officers' ward-room. (31) Upper, or main, deck; 30 guns. (32) Middle deck; 28 guns. (33) Gun deck; 30 guns. (34) Orlop deck. (35) After gunpowder magazine. (36) Water and provisions in hold. (37) Main-mast step. (38) Spars, sails and rope store on Orlop deck. (39) Stores in hold. The *Victory* carried 370 tons of ballast, 400 tons of water, 300 tons of provisions and 100 tons of solid, iron cannon-balls. (40) Admiral's entrance.



HOW THE GUNS WERE FIRED

(A) Touch hole. (B) Gunpowder 'cartridge' rammed in. (C) Wads of yarn. (D) Solid, iron cannon-ball. The touch hole was filled with powder and ignited by a length of smouldering wick. (E) Elevating wedge. (F) Trunnion. (G) Gun-breeching, to take the recoil. (H) Ladle, or ram-rod, for loading.

A GIANT DIESEL - ELECTRIC LOCOMOTIVE

A TYPICAL AMERICAN 2,000 H.P. LONG DISTANCE UNIT

CYCLE OF OPERATIONS

1. 1,000 h.p. Diesel Engines which drive 2. 600 volt Generators. 3. Auxiliary Generators. 4. Electric cables to 5. Traction Motors (one to each axle). 6. Motor air cooling ducts. 7. Air blower for electric motors. 8. Fuel oil tank (1,200 gallons). 9. Oil fuel pump. 10. Diesel engine exhaust. 11. Air intake grills for radiators. 12. Cooling fans for generator and radiators. 13. Radiators. 14. Oil fired boiler for train heating. 15. Rear six-wheeled bogie. 16. Front six-wheeled bogie. 17. Brake cylinders. 18. Opening for automatic coupling. 19. Electric headlight. 20. Sidelight. 21. Water tanks for train heating boiler. 22. Control panel. 23. Dual control cab. 24. Siren.

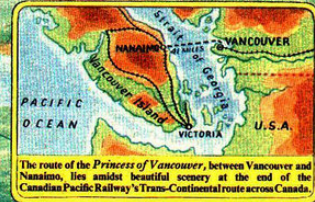
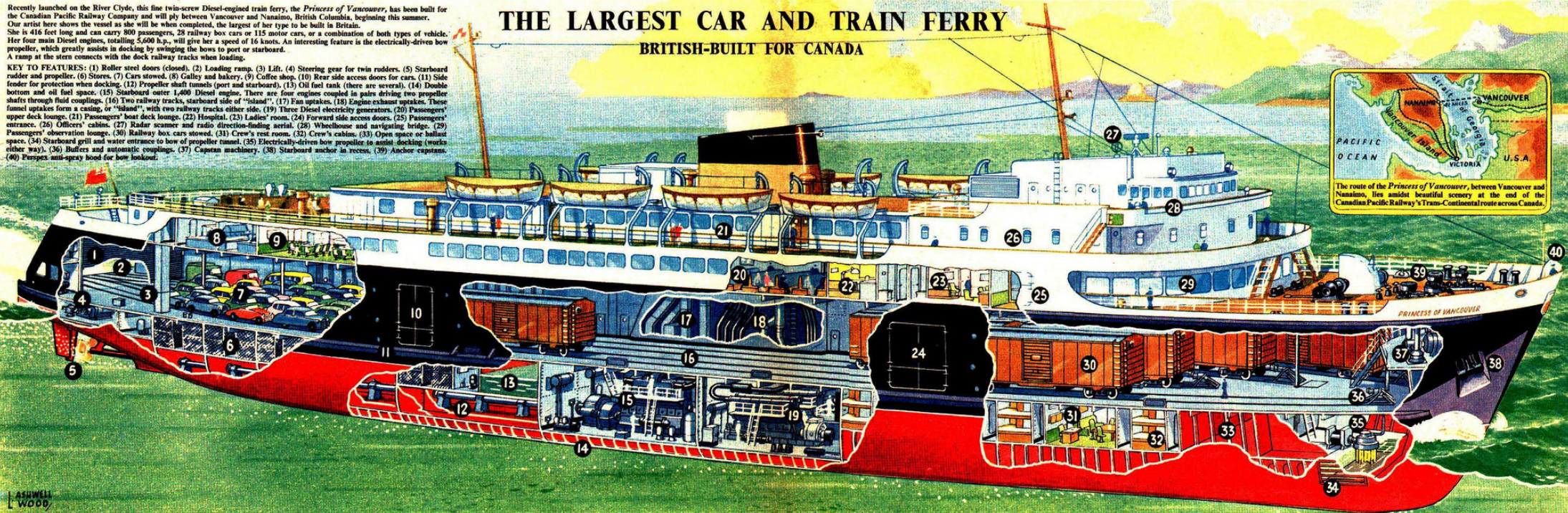


Recently launched on the River Clyde, this fine twin-screw Diesel-engined train ferry, the *Princess of Vancouver*, has been built for the Canadian Pacific Railway Company and will ply between Vancouver and Nanaimo, British Columbia, beginning this summer. Our artist here shows the vessel as she will be when completed, the largest of her type to be built in Britain. She is 416 feet long and can carry 800 passengers, 28 railway box cars or 115 motor cars, or a combination of both types of vehicle. Her four main Diesel engines, totalling 5,600 h.p., will give her a speed of 16 knots. An interesting feature is the electrically-driven bow propeller, which greatly assists in docking by swinging the bows to port or starboard. A ramp at the stern connects with the dock railway tracks when loading.

KEY TO FEATURES: (1) Roller steel doors (closed). (2) Loading ramp. (3) Lift. (4) Steering gear for twin rudders. (5) Starboard rudder and propeller. (6) Stores. (7) Cars stowed. (8) Galley and bakery. (9) Coffee shop. (10) Rear side access doors for cars. (11) Side fender for protection when docking. (12) Propeller shaft tunnels (port and starboard). (13) Oil fuel tank (there are several). (14) Double bottom and oil fuel space. (15) Starboard outer 1,400 Diesel engine. There are four engines coupled in pairs driving two propeller shafts through fluid couplings. (16) Two railway tracks, starboard side of "island". (17) Fan uptakes. (18) Engine exhaust uptakes. These funnel uptakes form a casing, or "island", with two railway tracks either side. (19) Three Diesel electricity generators. (20) Passengers' upper deck lounge. (21) Passengers' boat deck lounge. (22) Hospital. (23) Ladies' room. (24) Forward side access doors. (25) Passengers' entrance. (26) Officers' cabins. (27) Radar scanner and radio direction-finding aerial. (28) Wheelhouse and navigating bridge. (29) Passengers' observation lounge. (30) Railway box cars stowed. (31) Crew's rest room. (32) Crew's cabins. (33) Open space or ballast space. (34) Starboard grill and water entrance to bow of propeller tunnel. (35) Electrically-driven bow propeller to assist docking (works either way). (36) Buffers and automatic couplings. (37) Capstan machinery. (38) Starboard anchor in recess. (39) Anchor capstans. (40) Perspex anti-spray hood for bow lookout.

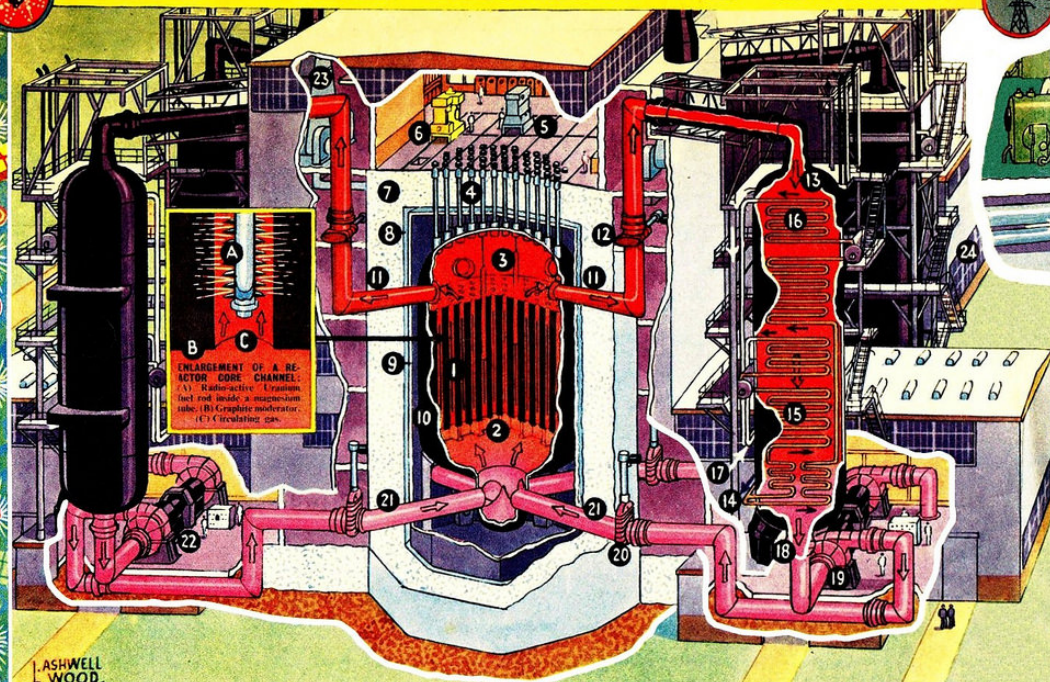
THE LARGEST CAR AND TRAIN FERRY

BRITISH-BUILT FOR CANADA

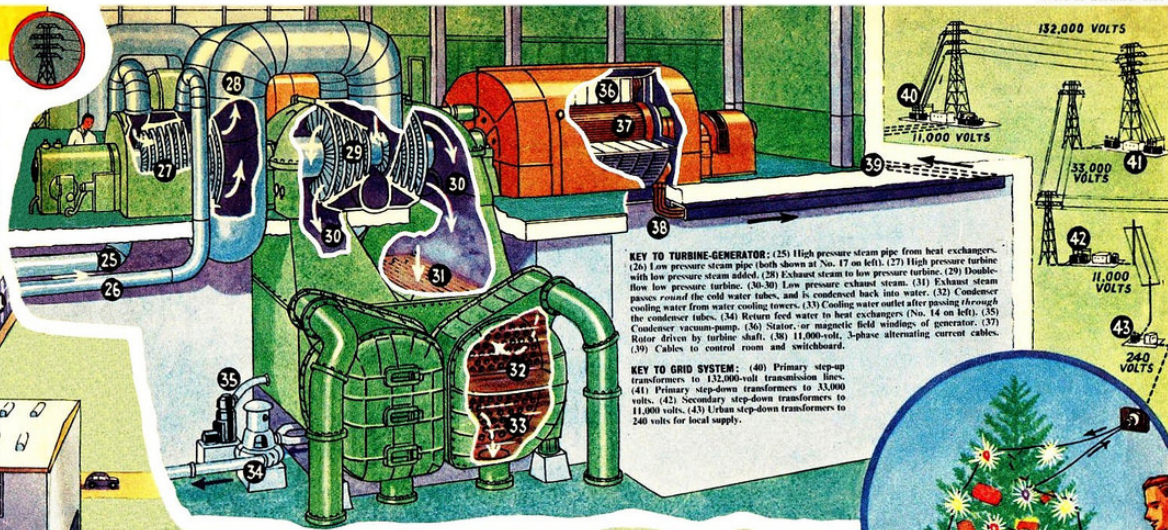


The route of the *Princess of Vancouver*, between Vancouver and Nanaimo, lies amidst beautiful scenery at the end of the Canadian Pacific Railway's Trans-Continental route across Canada.

ATOMIC - POWERED ELECTRICITY FOR CHRISTMAS



ASHWELL
WOOD



KEY TO TURBINE-GENERATOR: (25) High pressure steam pipe from heat exchangers. (26) Low pressure steam pipe (both shown at No. 17 on left). (27) High pressure turbine with low pressure steam added. (28) Exhaust steam to low pressure turbine. (29) Double-flow low pressure turbine. (30-30) Low pressure exhaust steam. (31) Exhaust steam passes round the cold water tubes, and is condensed back into water. (32) Condenser cooling water from water cooling towers. (33) Cooling water outlet after passing through the condenser tubes. (34) Return feed water to heat exchangers (No. 14 on left). (35) Condenser vacuum-pump. (36) Stator, or magnetic field windings of generator. (37) Rotor driven by turbine shaft. (38) 11,000-volt, 3-phase alternating current cables. (39) Cables to control room and switchboard.

KEY TO GRID SYSTEM: (40) Primary step-up transformers to 132,000-volt transmission lines. (41) Primary step-down transformers to 33,000 volts. (42) Secondary step-down transformers to 11,000 volts. (43) Urban step-down transformers to 240 volts for local supply.

Calder Hall, the world's first atomic power station, will be feeding electricity into the National Grid system this Christmas. Some 46,000 of our population will, unknown to themselves, be using this electricity for Christmas festivities and household services, but this is only half the eventual output of Calder Hall. In our last week's issue, we showed the whole layout of Calder Hall 'A' Station; in this special Christmas issue, we show in more detail how atomic power, or nuclear fission, is harnessed to the generation of electricity and how it reaches our homes. The nuclear power of one reactor is already saving Britain 2½ tons of coal every hour, with only two turbines running. Each of the four generators is capable of generating 23 megawatts of electricity. (1,000 watts is a kilowatt; 1,000 kilowatts, or 1,000,000 watts, is a megawatt.) Watts are a measure of power used, and a 100-watt electric lamp will use 100 watts in an hour. A one-kilowatt electric fire will use 1,000 watts in the same time, so one generator alone will produce 23,000,000 watts. Calder Hall is a British achievement; it is a demonstration of what British skill can do to make sure that this country remains one of the industrial leaders of the world.

KEY TO THE ATOMIC REACTOR AND STEAM SUPPLY: (1) The reactor core of graphite moderator with rods of Uranium 235, the fuel, suspended in channels. The nuclear fission of the uranium atoms produces great heat. (2) Grid support for the graphite core, which weighs over 1,000 tons. (3) Control rods; these are dropped to shut down the reactor when necessary. (4) Uranium charging tubes. (5) Charging machine. (6) Discharging machine. (7) 8 ft.-thick concrete shielding against radiation. (8) Reactor cooling air duct. (9) Steel inner-shield. (10) Pressure vessel. (11-11) Outlets for the hot carbon dioxide gases heated to enormous temperature by passing through

the core. (12) Hot gas valve. (13) Hot gas inlet to heat exchangers, or 'boilers'. Here the hot gases produce steam in the exchanger tubes. (14) Water feed pipes from turbine condensers. (15) Low pressure steam exchanger tubes. The rising feed water is converted into steam. (16) High pressure steam exchanger tubes. (17) Low and high pressure steam pipes to turbines. (18) Cool gas outlet. (19) Carbon dioxide gas circulating fans. (20) Cool gas valve. (21-21) Cool gas returns to reactor to be heated again. (22) Similar fans and piping for left-hand heat exchanger; there are four of these to one reactor. (23) Reactor cooling air fans. (24) Turbine house.



At home, the electricity finally reaches the familiar fairy-lights at Christmas. These are 'series' wired, so that the 240-volt supply is spread over 12 lamps of 20 volts each.

ACTION 'SEA-STATIONS'

A PLAN to build a chain of artificial islands across the Atlantic Ocean to help aircraft communications has been approved by the Ministry of Aviation. The aim is to provide more reliable radio links between airliners and land bases as traffic increases across the Atlantic. It is estimated that a total of 10,000 people will be crossing the Atlantic at one time during the peak period this year.

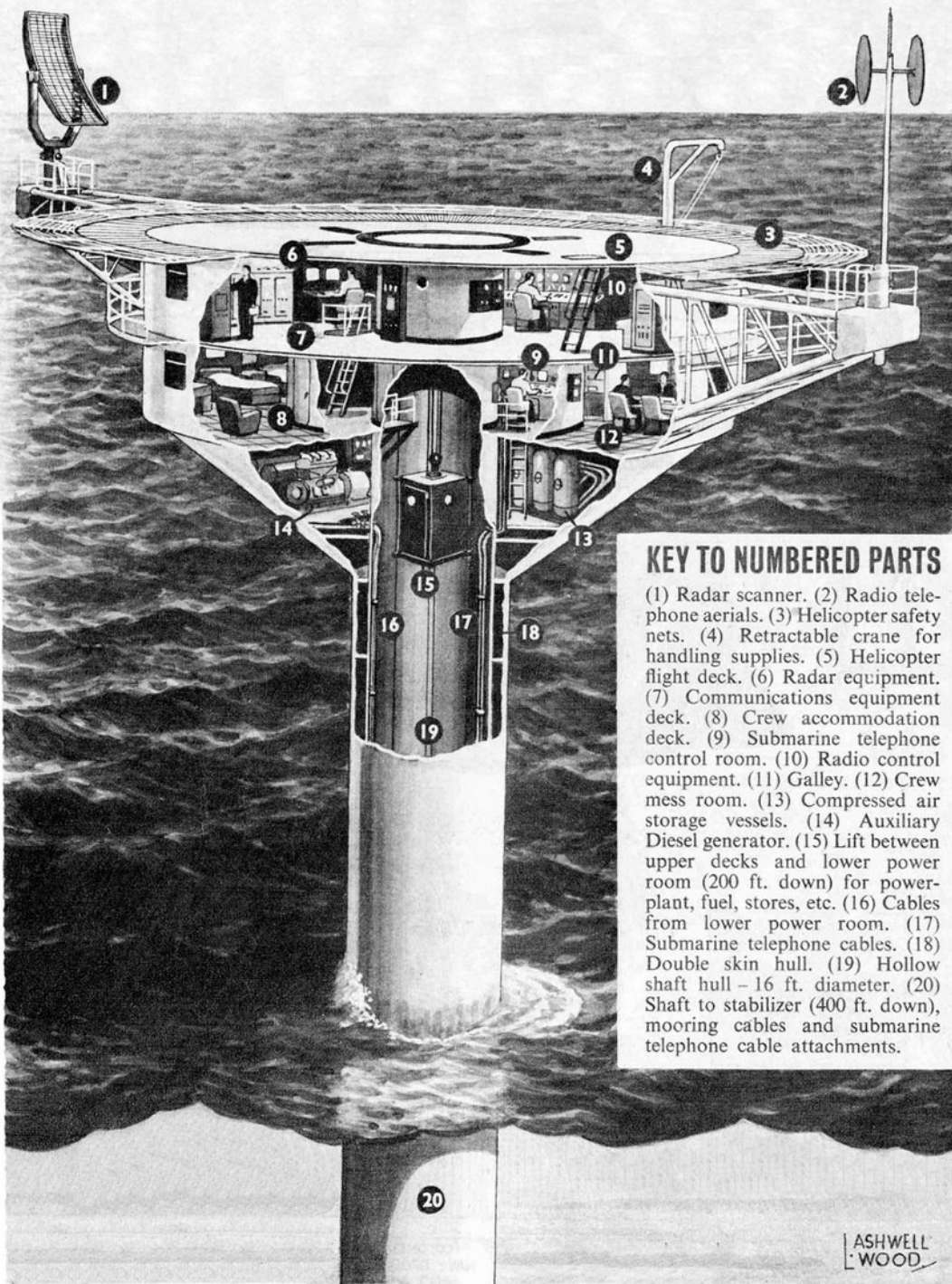
The 'islands', called Sea-stations, will be like gigantic buoys. The part above the surface will include a helicopter flight deck, living accommodation for a dozen men, and rooms for radar, radio and other navigation equipment.

Below each station, built like a submarine with a double skin, will be a 16-ft.-wide metal tube going down 400 ft. into the ocean. At the bottom will be a stabilizing or ballast chamber connected to mooring cables and submarine telephone cables.

Life in the Sea-stations will be quite comfortable. Even with waves up to 100 ft. high, test tank experiments have proved that movement will be comparatively slight.

Weather forecasting and reporting services from the 'islands' will help ships as well as aircraft.

Cammell Laird, the shipbuilders of Birkenhead, will build the 'islands' and Submarine Cables Ltd., of Greenwich, will provide the communications equipment.



KEY TO NUMBERED PARTS

(1) Radar scanner. (2) Radio telephone aerials. (3) Helicopter safety nets. (4) Retractable crane for handling supplies. (5) Helicopter flight deck. (6) Radar equipment. (7) Communications equipment deck. (8) Crew accommodation deck. (9) Submarine telephone control room. (10) Radio control equipment. (11) Galley. (12) Crew mess room. (13) Compressed air storage vessels. (14) Auxiliary Diesel generator. (15) Lift between upper decks and lower power room (200 ft. down) for power-plant, fuel, stores, etc. (16) Cables from lower power room. (17) Submarine telephone cables. (18) Double skin hull. (19) Hollow shaft hull - 16 ft. diameter. (20) Shaft to stabilizer (400 ft. down), mooring cables and submarine telephone cable attachments.

A Sea-station floating vertically in the sea with the greater part of its shaft submerged. (21) Lower power room. (22) Stabilizer and cable attachments. (23) Mooring cables. (24) Submarine telephone cables.

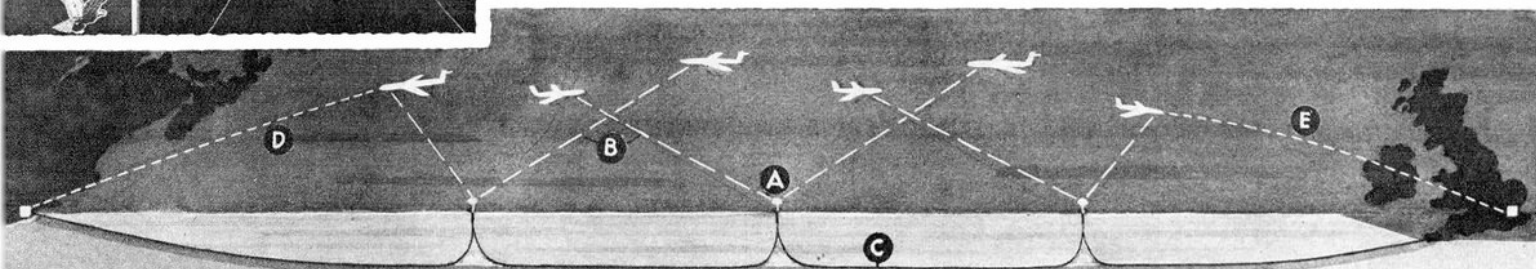
AN EAGLE
cutaway
DRAWING

ASHWELL
WOOD

RADIO CONTACT

Owing to the curvature of the earth, radio contact with aircraft over wide oceans like the Atlantic, between London and New York, becomes less reliable when the aircraft is out of range of its land bases. The Sea-station island will be in constant contact with aircraft

by radar and radio and by submarine telephone with the land bases. (A) Sea-stations about 650 miles apart. (B) Radio contacts. (C) Shore-to-shore submarine telephone contacts (3,400 miles). (D-E) Land-based radio contacts.



CANADAIR CL-44

— THE TRANSPORT THAT CAN ALMOST WAG ITS TAIL!

BEARING a marked family resemblance to the Bristol Britannia, from which it was developed, the Canadair CL-44 swing-tail freighter first flew on 16th November, 1960. It was based on the CL-28 Argus maritime reconnaissance aircraft (also derived from the Britannia), an earlier Canadair product supplied to the Royal

Canadian Air Force. The CL-44 was also first ordered by the RCAF.

In its original form as an orthodox transport/freighter, the CL-44 was criticised for the fact that the side-door loading arrangements did not make full use of the fuselage capacity.

To overcome this, Canadair introduced a novel and unique system of hinging the whole tail assembly so

that it could be swung to one side, permitting direct loading into the aft fuselage.

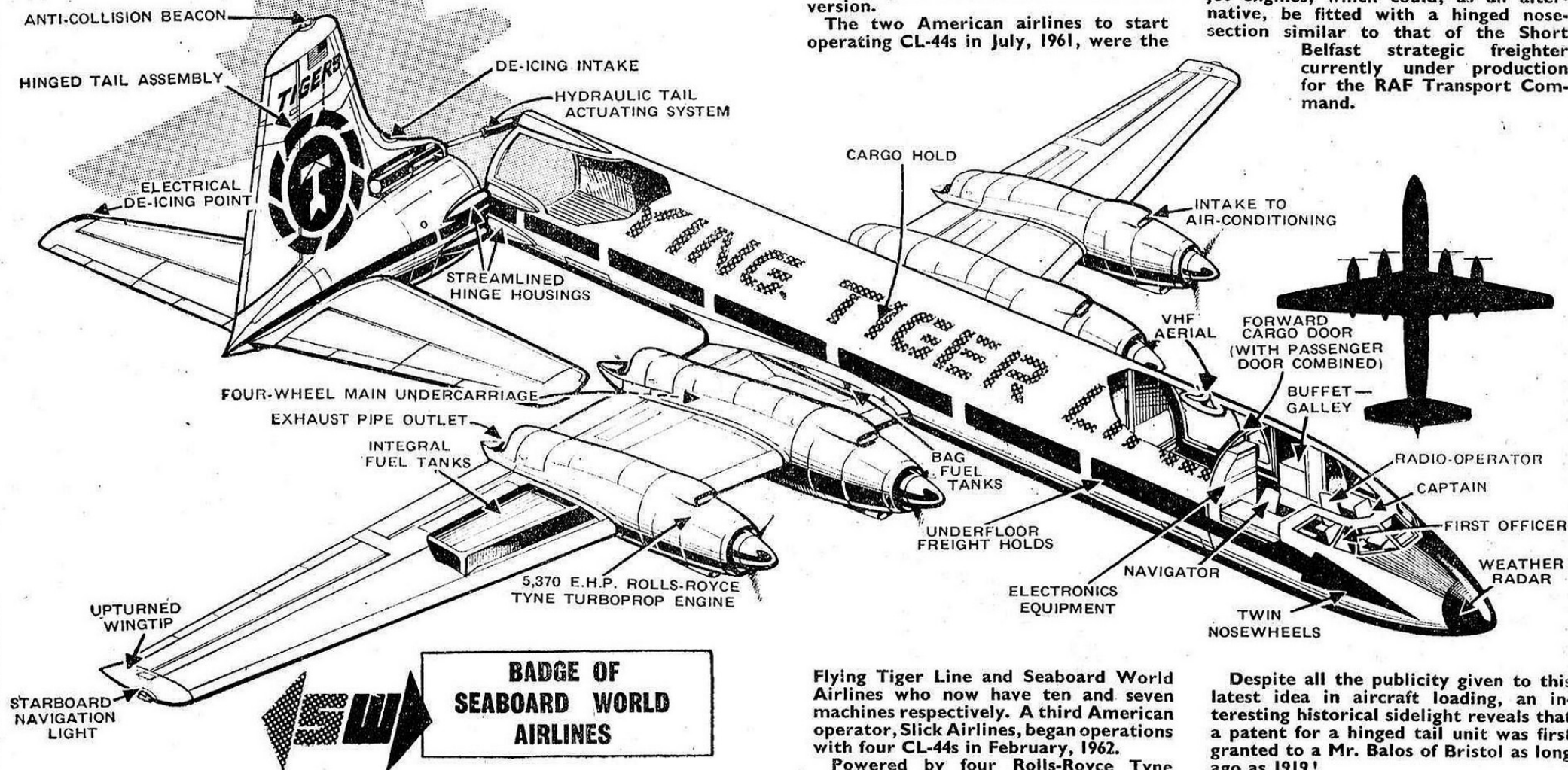
The illustration clearly shows the tail in its fully open position, while the shaded area indicates it in normal flight position.

It is this version, known as the CL-44D-4, which was ordered by two American operators in 1959 to enter service in mid-1961. Designated CC-106, the RCAF have also accepted a militarised side-loading version.

The two American airlines to start operating CL-44s in July, 1961, were the

turboprops, the CL-44 has a cruising speed of 373 mph at a height of 25,000 ft. Its dimensions are: span 142 ft. 3 ins., length 136 ft. 8 ins., and height 38 ft. 11 ins.

The CL-44 is, in fact, the first of its kind, and may well set a design fashion for converting any normal passenger machine to full freighter standard—except perhaps those with tail-mounted jet engines, which could, as an alternative, be fitted with a hinged nose-section similar to that of the Short Belfast strategic freighter currently under production for the RAF Transport Command.

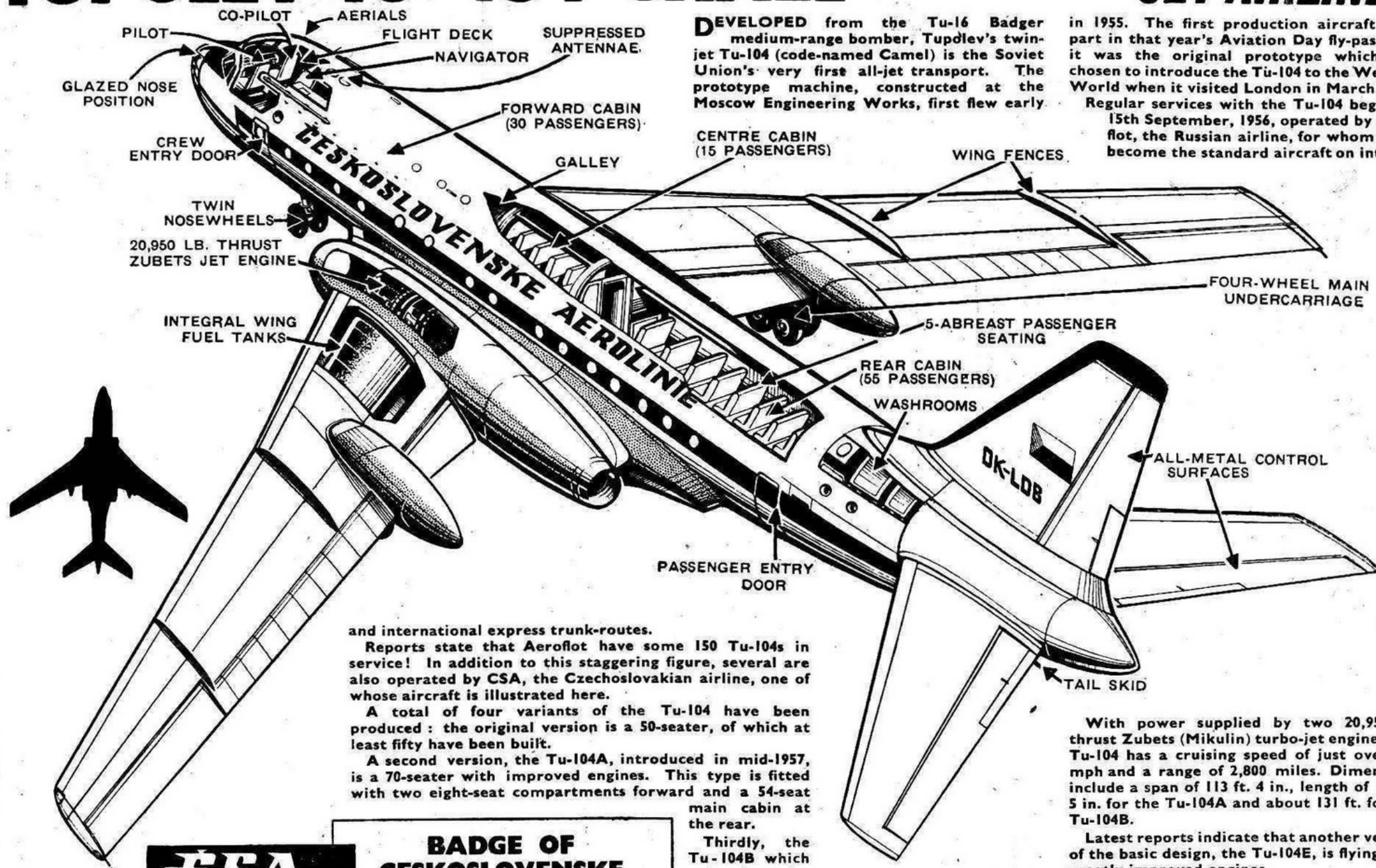


Flying Tiger Line and Seaboard World Airlines who now have ten and seven machines respectively. A third American operator, Slick Airlines, began operations with four CL-44s in February, 1962.

Powered by four Rolls-Royce Tyne

Despite all the publicity given to this latest idea in aircraft loading, an interesting historical sidelight reveals that a patent for a hinged tail unit was first granted to a Mr. Balos of Bristol as long ago as 1919!

TUPOLEV Tu-104 CAMEL - RUSSIA'S FIRST JET AIRLINER



DEVELOPED from the Tu-16 Badger medium-range bomber, Tupolev's twin-jet Tu-104 (code-named Camel) is the Soviet Union's very first all-jet transport. The prototype machine, constructed at the Moscow Engineering Works, first flew early

in 1955. The first production aircraft took part in that year's Aviation Day fly-past, but it was the original prototype which was chosen to introduce the Tu-104 to the Western World when it visited London in March, 1956.

Regular services with the Tu-104 began on 15th September, 1956, operated by Aeroflot, the Russian airline, for whom it has become the standard aircraft on internal

and international express trunk-routes.

Reports state that Aeroflot have some 150 Tu-104s in service! In addition to this staggering figure, several are also operated by CSA, the Czechoslovakian airline, one of whose aircraft is illustrated here.

A total of four variants of the Tu-104 have been produced: the original version is a 50-seater, of which at least fifty have been built.

A second version, the Tu-104A, introduced in mid-1957, is a 70-seater with improved engines. This type is fitted with two eight-seat compartments forward and a 54-seat main cabin at the rear.

Thirdly, the Tu-104B which entered service in 1959 has a fuselage of increased length over the earlier models, and features high-density seating arrangements for 100 passengers.

With power supplied by two 20,950 lb. thrust Zubets (Mikulin) turbo-jet engines, the Tu-104 has a cruising speed of just over 500 mph and a range of 2,800 miles. Dimensions include a span of 113 ft. 4 in., length of 127 ft. 5 in. for the Tu-104A and about 131 ft. for the Tu-104B.

Latest reports indicate that another version of the basic design, the Tu-104E, is flying with greatly improved engines.

A four-engined derivative of the Camel, known as the Tu-110, was built and flown, but this project has since been abandoned.



**BADGE OF
CESKOSLOVENSKE
AEROLINIE-CSA.**

FLYING SHIP!

NEITHER ship nor aircraft, yet a combination of both – that's the Hovercraft which, though still unique, has established itself as a recognized form of transport during the six years since the comparatively primitive prototype, the SRN 1, made history with its maiden voyage in 1959.

Passengers travelling to and from the Isle of Wight now have the opportunity of enjoying the world's most up-to-date means of travel, for the ferry service linking island and mainland is being operated by the very latest Hovercraft of its type, the Westland SRN 6 – a vehicle ideally suited to this form of ferry work for,

even in rough weather, it has a maximum speed of a smooth 60 knots, high-riding on its own cushion of air. Furthermore, the SRN 6 can cushion itself up the beach at the end of its run, discharge, load up, and turn around in quick time within a small area, thus doing away with the need for landing stages and docking facilities.

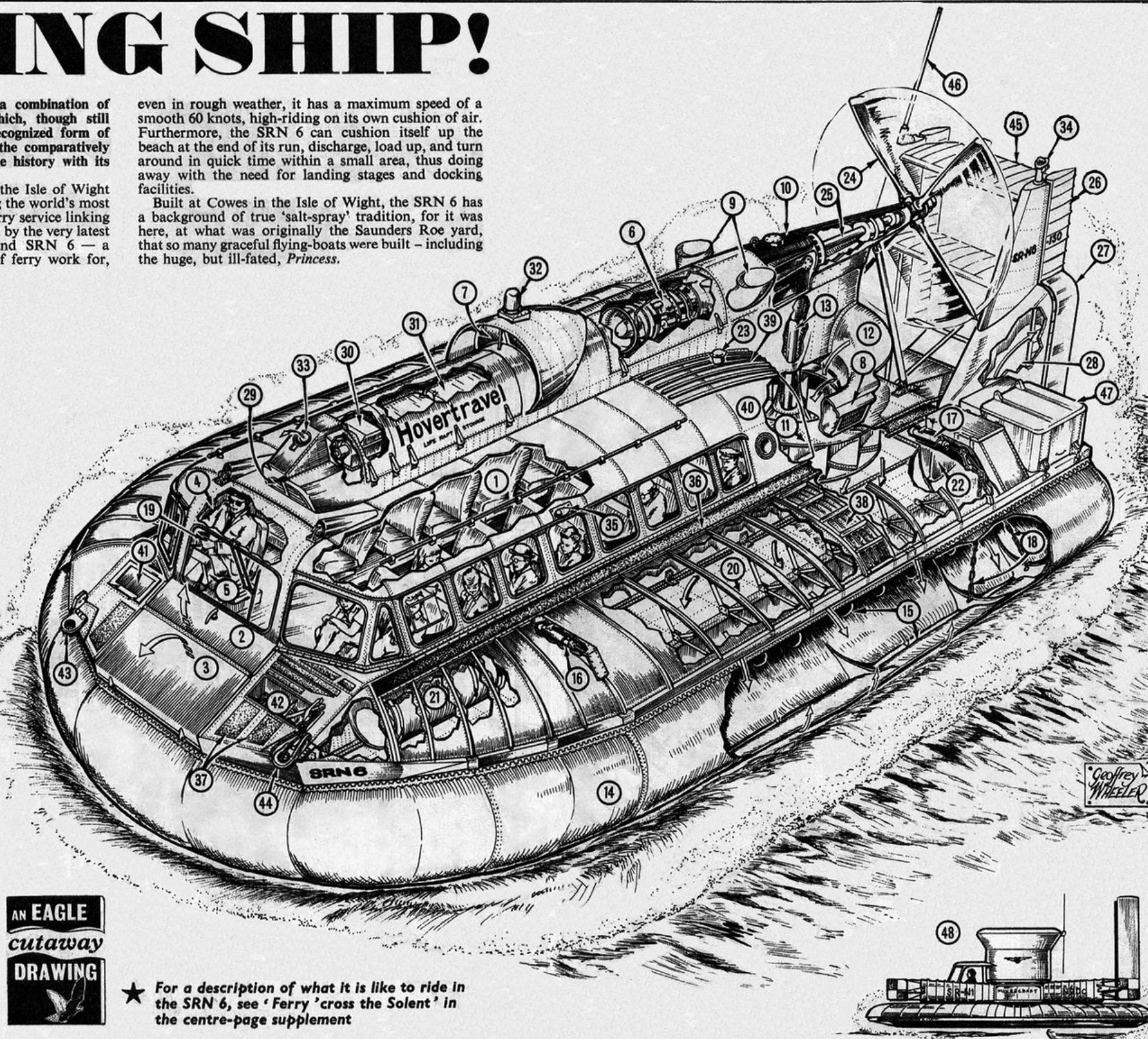
Built at Cowes in the Isle of Wight, the SRN 6 has a background of true 'salt-spray' tradition, for it was here, at what was originally the Saunders Roe yard, that so many graceful flying-boats were built – including the huge, but ill-fated, *Princess*.

KEY TO NUMBERED PARTS

(1) Passenger cabin space. (2) Lift-up access door to cabin. (3) Lower section of cabin access, swinging outwards to form a ramp into the cabin. (4) Driving position. (5) Driver's control panel. (6) Engine – a Bristol Siddeley Marine Gnome gas-turbine engine. (7) Raised halo-type ram air-intake for engine. (8) Main air-intakes for engines on each side of vehicle. Air-intakes are fitted with fine knit-mesh filters to prevent sand and spray being drawn into the engine. (9) Engine exhaust ducts. (10) Gearbox, dividing drive from engine to provide lift and propulsion. (11) 7-foot diameter lift fan. (12) Moulded glass-fibre air-intake to fan. (13) Driveshaft from gearbox to fan. (14) 4-foot deep flexible skirt surrounding vehicle. This contains air pressurized to 30 lb. per square inch by the rotation of the fan. Air escaping through the slot and apertures (15) forms the cushion on which the vehicle rides. (16 and 17) Hydraulic rams connected by chains (18) to the skirt. These raise and lower the skirt to control the air cushion, and are operated by the driver's skirt control column (19). (20) Buoyancy tanks along each side of vehicle. (21) Forward fuel-ballast tanks (port and starboard). (22) Aft fuel-ballast tank. These tanks are connected by pipes so that fuel may be transferred to adjust the vehicle's trim. (23) Fuel filler cap. (24) Dowty-Rotol 9-ft. diameter four-bladed propeller. This has a reversible pitch by which the vehicle may be propelled forwards or backwards. (25) Propeller driveshaft from gearbox. (26) Stabilizing fins and rudders. (27) Bucket rudders. (28) Ducts leading air from the cushion supply up through the bucket rudders. (29) Air inlet to cabin. (30) Cabin ventilating equipment. (31) Life-saving equipment – two inflatable 21-man dinghies. (32) Amber rotating flasher beacon. (33) Retractable searchlight. (34) Aft steaming and mooring lights. (35) Port and starboard navigation lights. (36, 37 and 38) Non-slip walkways. (39) Engine inspection platform. (40) Compartment containing main fuel tank, fuel pump and oil-cooling equipment. (41) Battery box. (42) Anchor stowage. (43 and 44) Towing and mooring fairleads. (45) Trimming elevators. (46) V.H.F. radio equipment aerial. (47) Luggage panniers. (48) The prototype hovercraft – the SRN 1.



★ For a description of what it is like to ride in the SRN 6, see 'Ferry' cross the Solent' in the centre-page supplement



Geoffrey Wheeler

The fifteenth warship of the Royal Navy to be so named, *H.M.S. Eagle* is Britain's largest and latest aircraft carrier. In this issue of *EAGLE*, we exclusively introduce the first drawing of her external modernization features - her new radar aerials, angled deck and steam catapults.

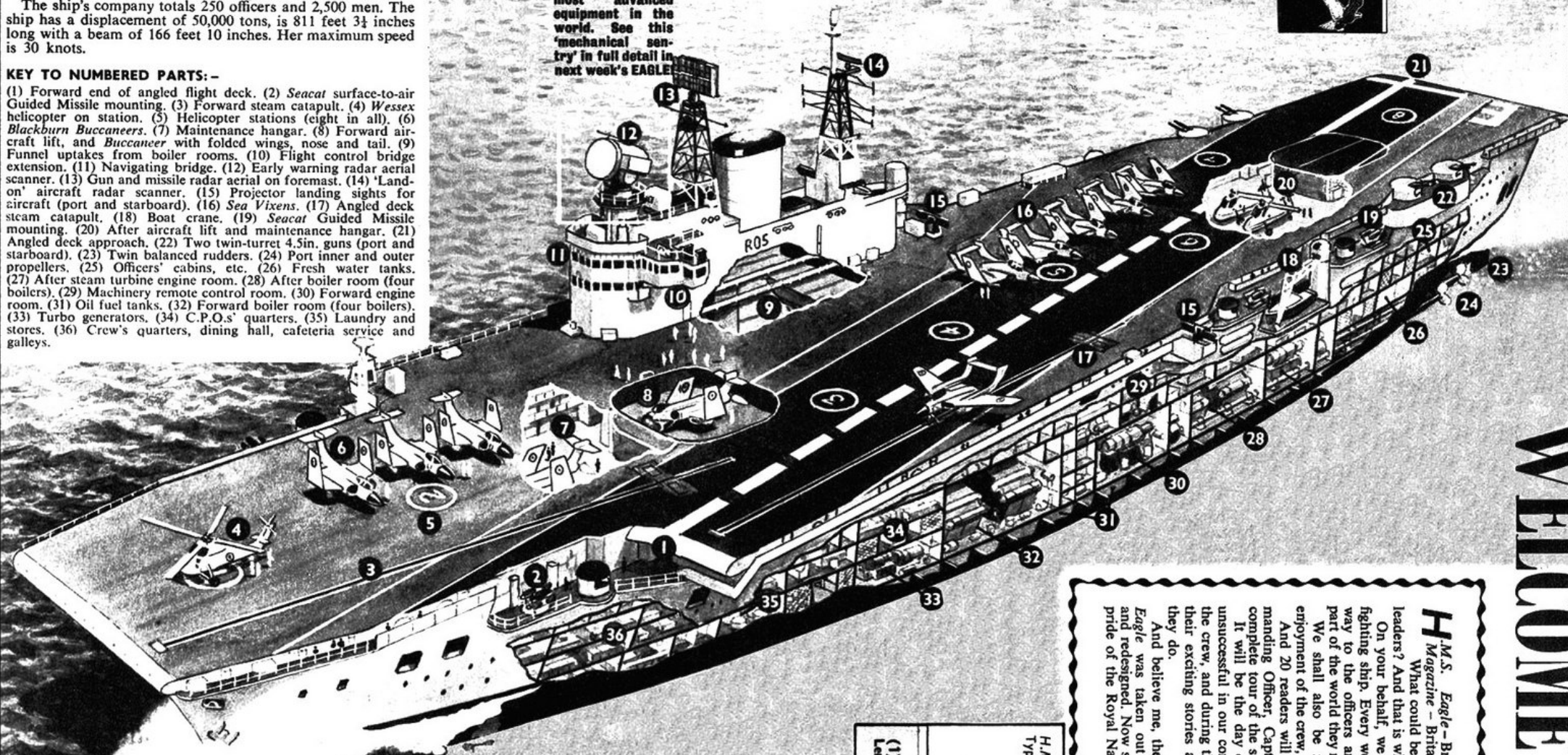
Other modern features include the 3D radar in conjunction with A.D.A. (Action Data Automation) - an automatic computer system, the complex 'brain' of which handles all radar information to control the ship's aircraft.

The ship's company totals 250 officers and 2,500 men. The ship has a displacement of 50,000 tons, is 811 feet 3 1/4 inches long with a beam of 166 feet 10 inches. Her maximum speed is 30 knots.

KEY TO NUMBERED PARTS:-

(1) Forward end of angled flight deck. (2) *Seacat* surface-to-air Guided Missile mounting. (3) Forward steam catapult. (4) *Wessex* helicopter on station. (5) Helicopter stations (eight in all). (6) *Blackburn Buccaneers*. (7) Maintenance hangar. (8) Forward aircraft lift, and *Buccaneer* with folded wings, nose and tail. (9) Funnel uptakes from boiler rooms. (10) Flight control bridge extension. (11) Navigating bridge. (12) Early warning radar aerial scanner. (13) Gun and missile radar aerial on foremast. (14) 'Land-on' aircraft radar scanner. (15) Projector landing sights for aircraft (port and starboard). (16) *Sea Vixens*. (17) Angled deck steam catapult. (18) Boat crane. (19) *Seacat* Guided Missile mounting. (20) After aircraft lift and maintenance hangar. (21) Angled deck approach. (22) Two twin-turret 4.5in. guns (port and starboard). (23) Twin balanced rudders. (24) Port inner and outer propellers. (25) Officers' cabins, etc. (26) Fresh water tanks. (27) After steam turbine engine room. (28) After boiler room (four boilers). (29) Machinery remote control room. (30) Forward engine room. (31) Oil fuel tanks. (32) Forward boiler room (four boilers). (33) Turbo generators. (34) C.P.O.s' quarters. (35) Laundry and stores. (36) Crew's quarters, dining hall, cafeteria service and galleys.

This radar scanner is *H.M.S. Eagle's* watchdog against attackers. It is the most advanced equipment in the world. See this 'mechanical sentry' in full detail in next week's *EAGLE*.



WELCOME ABOARD

H.M.S. Eagle - Britain's finest aircraft carrier. *EAGLE Magazine* - Britain's finest boys' paper.

What could be more natural than a link between these two leaders? And that is what we have done.

On your behalf, we have 'adopted' Britain's biggest and newest fighting ship. Every week, copies of your magazine will find their way to the officers and crew of *H.M.S. Eagle*, no matter what part of the world they may be in.

We shall also be making a presentation of canoes for the enjoyment of the crew, on or off duty.

And 20 readers will have the opportunity of meeting the Commanding Officer, Captain L. D. Empson, and being taken on a complete tour of the ship.

It will be the day of a lifetime. But for those boys who are unsuccessful in our competition, we shall be interviewing many of the crew, and during the next few weeks we shall be bringing you their exciting stories and telling you something about the work they do.

And believe me, their work is really exciting. In 1959, *H.M.S. Eagle* was taken out of commission to be completely refitted and redesigned. Now she is being prepared for her trip - truly the pride of the Royal Navy.

H.M.S. EAGLE AIRCRAFT LINE-UP



(1) Blackburn Buccaneer S.1. Strike aircraft - Length 63ft. 5in.



(2) Hawker Siddeley Sea Vixen A.W.F.L. All-weather fighter - Length 53ft. 6in.



(3) Westland Wessex A.S.1. Anti-submarine helicopter - Length 45ft. 6in.



(4) Fairey Gannet A.E.W.3. Airborne early warning - length 44ft.

H.M.S. GOSSACK

Length, 355 ft. 6 ins.; beam, 36 ft. 6 ins.;
1,870 tons; speed, 36½ knots; 44,000 h.p.
engine capacity; complement, 219.

THE EPIC OF THE *ALTMARK*

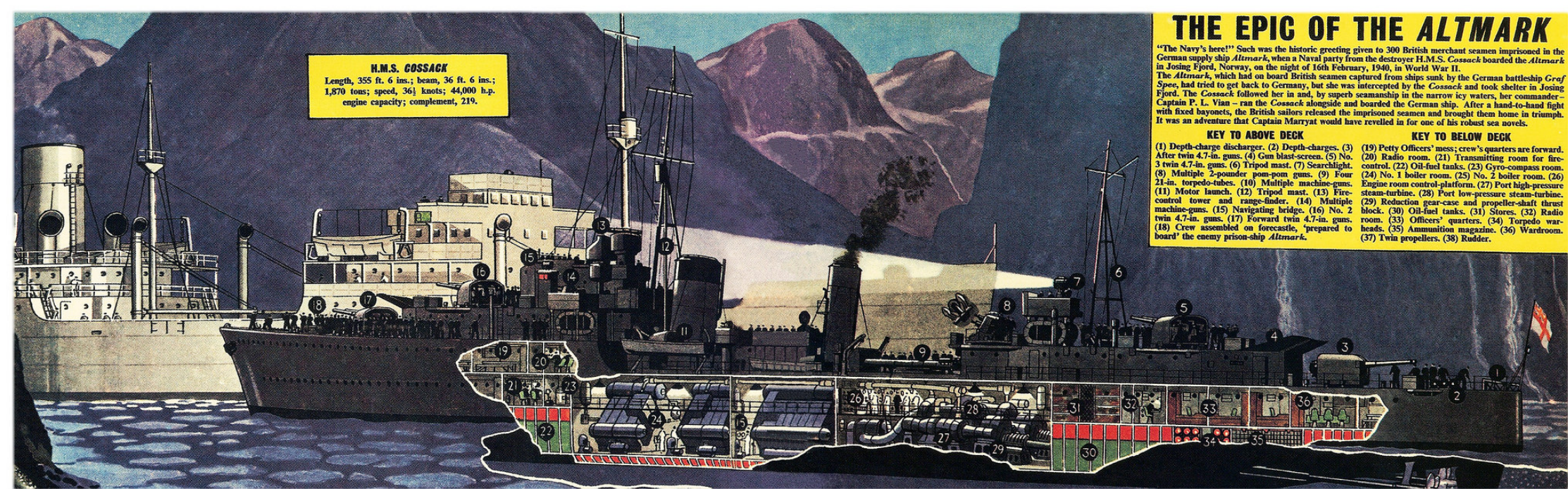
"The Navy's here!" Such was the historic greeting given to 300 British merchant seamen imprisoned in the German supply ship *Altmark*, when a Naval party from the destroyer H.M.S. *Cossack* boarded the *Altmark* in Josing Fjord, Norway, on the night of 16th February, 1940, in World War II. The *Altmark*, which had on board British seamen captured from ships sunk by the German battleship *Graf Spee*, had tried to get back to Germany, but she was intercepted by the *Cossack* and took shelter in Josing Fjord. The *Cossack* followed her in and, by superb seamanship in the narrow icy waters, her commander—Captain P. L. Vian—ran the *Cossack* alongside and boarded the German ship. After a hand-to-hand fight with fixed bayonets, the British sailors released the imprisoned seamen and brought them home in triumph. It was an adventure that Captain Marryat would have revelled in for one of his robust sea novels.

KEY TO ABOVE DECK

(1) Depth-charge discharger. (2) Depth-charges. (3) After twin 4.7-in. guns. (4) Gun blast-screen. (5) No. 3 twin 4.7-in. guns. (6) Tripod mast. (7) Searchlight. (8) Multiple 2-pounder pom-pom guns. (9) Four 21-in. torpedo-tubes. (10) Multiple machine-guns. (11) Motor launch. (12) Tripod mast. (13) Fire-control tower and range-finder. (14) Multiple machine-guns. (15) Navigating bridge. (16) No. 2 twin 4.7-in. guns. (17) Forward twin 4.7-in. guns. (18) Crew assembled on forecastle, 'prepared to board' the enemy prison-ship *Altmark*.

KEY TO BELOW DECK

(19) Petty Officers' mess; crew's quarters are forward. (20) Radio room. (21) Transmitting room for fire-control. (22) Oil-fuel tanks. (23) Gyro-compass room. (24) No. 1 boiler room. (25) No. 2 boiler room. (26) Engine room control-platform. (27) Port high-pressure steam-turbine. (28) Port low-pressure steam-turbine. (29) Reduction gear-case and propeller-shaft thrust block. (30) Oil-fuel tanks. (31) Stores. (32) Radio room. (33) Officers' quarters. (34) Torpedo war-heads. (35) Ammunition magazine. (36) Wardroom. (37) Twin propellers. (38) Rudder.



THE M.V. BARDIC FERRY

This is the first of two ferries which have been designed for the Irish Sea (Preston-Larne) service of the Atlantic Steam Navigation Co., Ltd. She has been built by Wm. Denny and Brothers Ltd., of Dumbarton, and will be joined next year by the almost identical *Ionic Ferry*. The main feature of her design is a long vehicle deck which extends almost the whole length of the hull. This is designed to take all sizes of commercial vehicle, and has space for some 48 trailers and 10 private cars. These enter over a hydraulically operated stern ramp which, when closed, forms a watertight door. On the upper deck there is a garage for 3 private cars, and space for 19 containers. These are handled by shore cranes or, if necessary, by the ship's equipment. Accommodation is provided for 15 first class and 38 second class passengers, and for these there are 4 public rooms, 2 lounges and 2 dining saloons. Including the master, the *Bardic Ferry* has a crew of 49. The ship has an overall length of 388 ft. and a moulded breadth of 52 ft. 6 ins. At 3,000 b.h.p. her two 10-cylinder Sulzer Diesel engines give a speed of 14 knots.

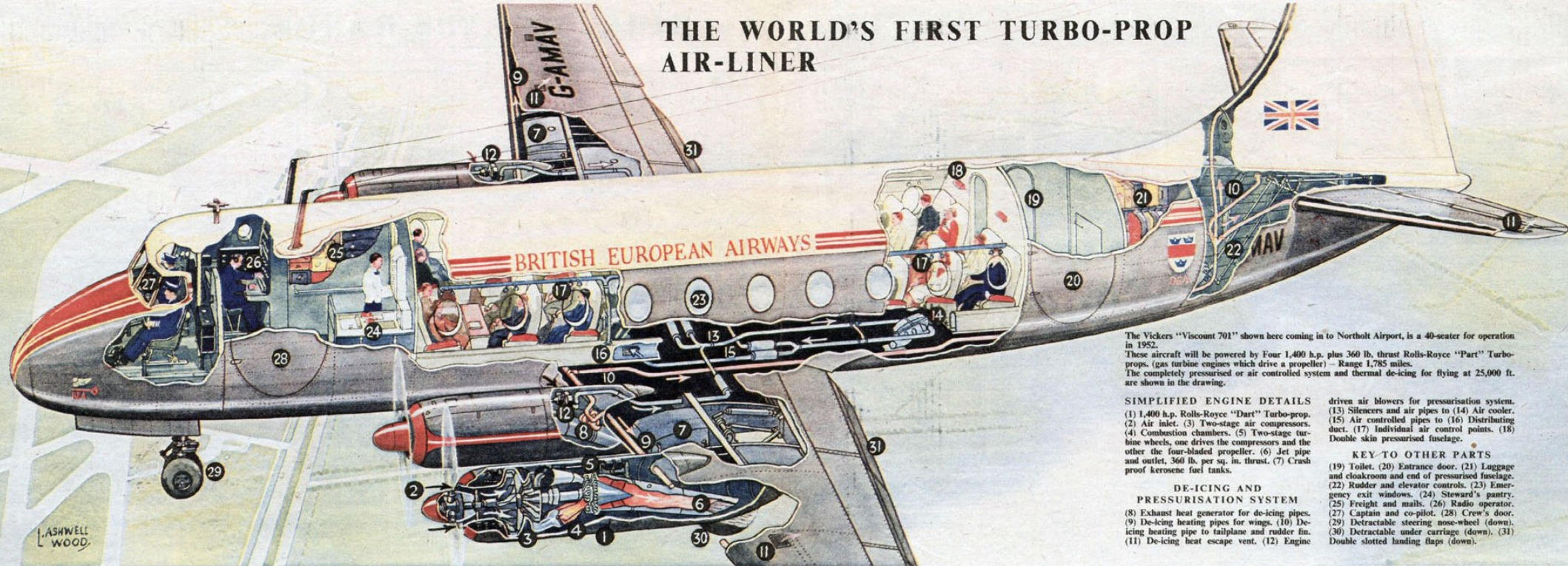


KEY TO NUMBERED PARTS

1. Deck shelter.
2. 2nd Class lounge.
3. 2 berth passenger cabin (left), Officers' lounge (right).
4. 1st Class lounge.
5. 2nd Class dining saloon (1st Class on port side).
6. Steward's cabin right (office on left).
7. 2nd Class cabins (1st Class on port side).
8. Crew's cabins.
9. Ventilators for deck below.
10. Garage for 3 private cars.
11. Extra light on each mast for use when going astern.
12. 20-ton electric crane.
13. Containers carried on upper deck only.
14. Docking bridge.
15. Twin spade-type rudders.
16. Dry compartment.
17. Dry compartment.
18. Engine room uptake.
19. Starboard main engine (Sulzer 10-cylinder Diesel).
20. Boiler.
21. Stabilizer compartment (stabilizer shown housed).
22. Linen store.
23. Flour store.
24. Bow rudder (used when going astern).

LAURENCE DUNN

THE WORLD'S FIRST TURBO-PROP AIR-LINER



The Vickers "Viscount 701" shown here coming in to Northolt Airport, is a 40-seater for operation in 1952.

These aircraft will be powered by Four 1,400 h.p. plus 360 lb. thrust Rolls-Royce "Part" Turbo-props. (gas turbine engines which drive a propeller) - Range 1,785 miles.

The completely pressurised or air controlled system and thermal de-icing for flying at 25,000 ft. are shown in the drawing.

SIMPLIFIED ENGINE DETAILS

- (1) 1,400 h.p. Rolls-Royce "Dart" Turbo-prop.
- (2) Air inlet. (3) Two-stage air compressors.
- (4) Combustion chambers. (5) Two-stage turbine wheels, one drives the compressors and the other the four-bladed propeller. (6) Jet pipe and outlet, 360 lb. per sq. in. thrust. (7) Crash proof kerosene fuel tanks.

DE-ICING AND PRESSURISATION SYSTEM

- (8) Exhaust heat generator for de-icing pipes.
- (9) De-icing heating pipes for wings. (10) De-icing heating pipe to tailplane and rudder fin.
- (11) De-icing heat escape vent. (12) Engine

driven air blowers for pressurisation system. (13) Silencers and air pipes to (14) Air cooler. (15) Air controlled pipes to (16) Distributing duct. (17) Individual air control points. (18) Double skin pressurised fuselage.

KEY-TO OTHER PARTS

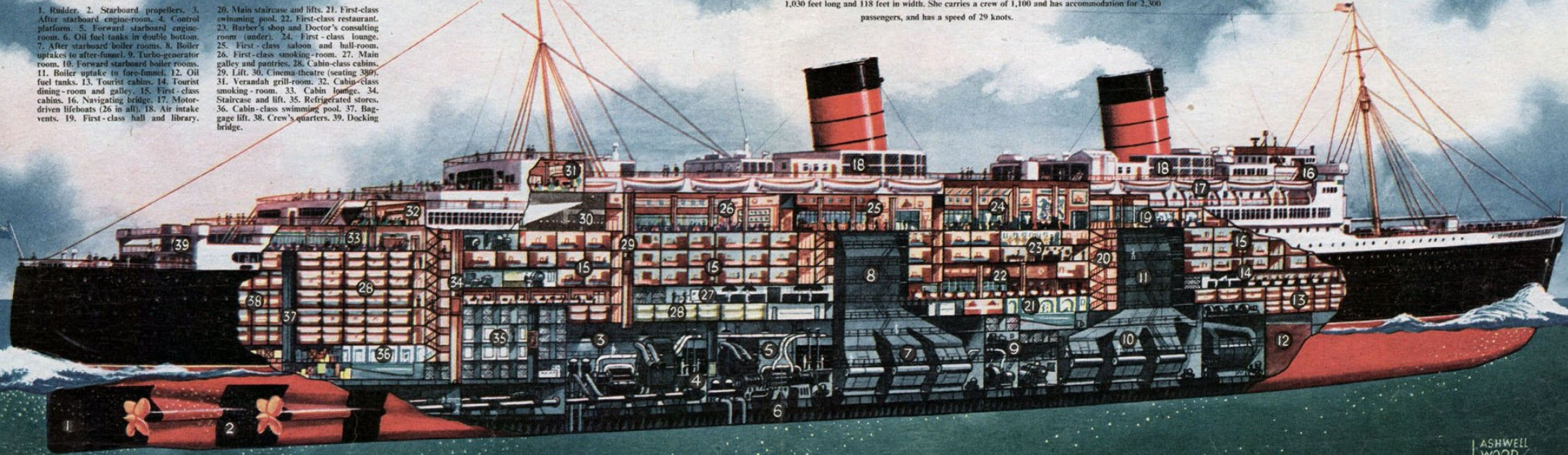
- (19) Toilet. (20) Entrance door. (21) Luggage and cloakroom and end of pressurised fuselage. (22) Rudder and elevator controls. (23) Emergency exit windows. (24) Steward's pantry. (25) Freight and mails. (26) Radio operator. (27) Captain and co-pilot. (28) Crew's door. (29) Retractable steering nose-wheel (down). (30) Retractable under carriage (down). (31) Double slotted landing flaps (down).

THE WORLD'S LARGEST LINER - THE "QUEEN ELIZABETH"

The "stateliest ship in being" aptly describes this wonderful 83,673-ton British luxury liner. She is 1,030 feet long and 118 feet in width. She carries a crew of 1,100 and has accommodation for 2,300 passengers, and has a speed of 29 knots.

KEY TO PARTS

1. Rudder. 2. Starboard propellers. 3. After starboard engine-room. 4. Control platform. 5. Forward starboard engine-room. 6. Oil fuel tanks in double bottom. 7. After starboard boiler rooms. 8. Boiler uptakes to after-funnel. 9. Turbo-generator room. 10. Forward starboard boiler rooms. 11. Boiler uptake to fore-funnel. 12. Oil fuel tanks. 13. Tourist cabins. 14. Tourist dining-room and galley. 15. First-class cabins. 16. Navigating bridge. 17. Motor-driven lifeboats (26 in all). 18. Air intake vents. 19. First-class hall and library. 20. Main staircase and lifts. 21. First-class swimming pool. 22. First-class restaurant. 23. Barber's shop and Doctor's consulting room (under). 24. First-class lounge. 25. First-class saloon and hall-room. 26. First-class smoking-room. 27. Main galley and pantries. 28. Cabin-class cabins. 29. Lift. 30. Cinema-theatre (seating 380). 31. Verandah grill-room. 32. Cabin-class smoking-room. 33. Cabin lounge. 34. Staircase and lift. 35. Refrigerated stores. 36. Cabin-class swimming pool. 37. Baggage lift. 38. Crew's quarters. 39. Docking bridge.



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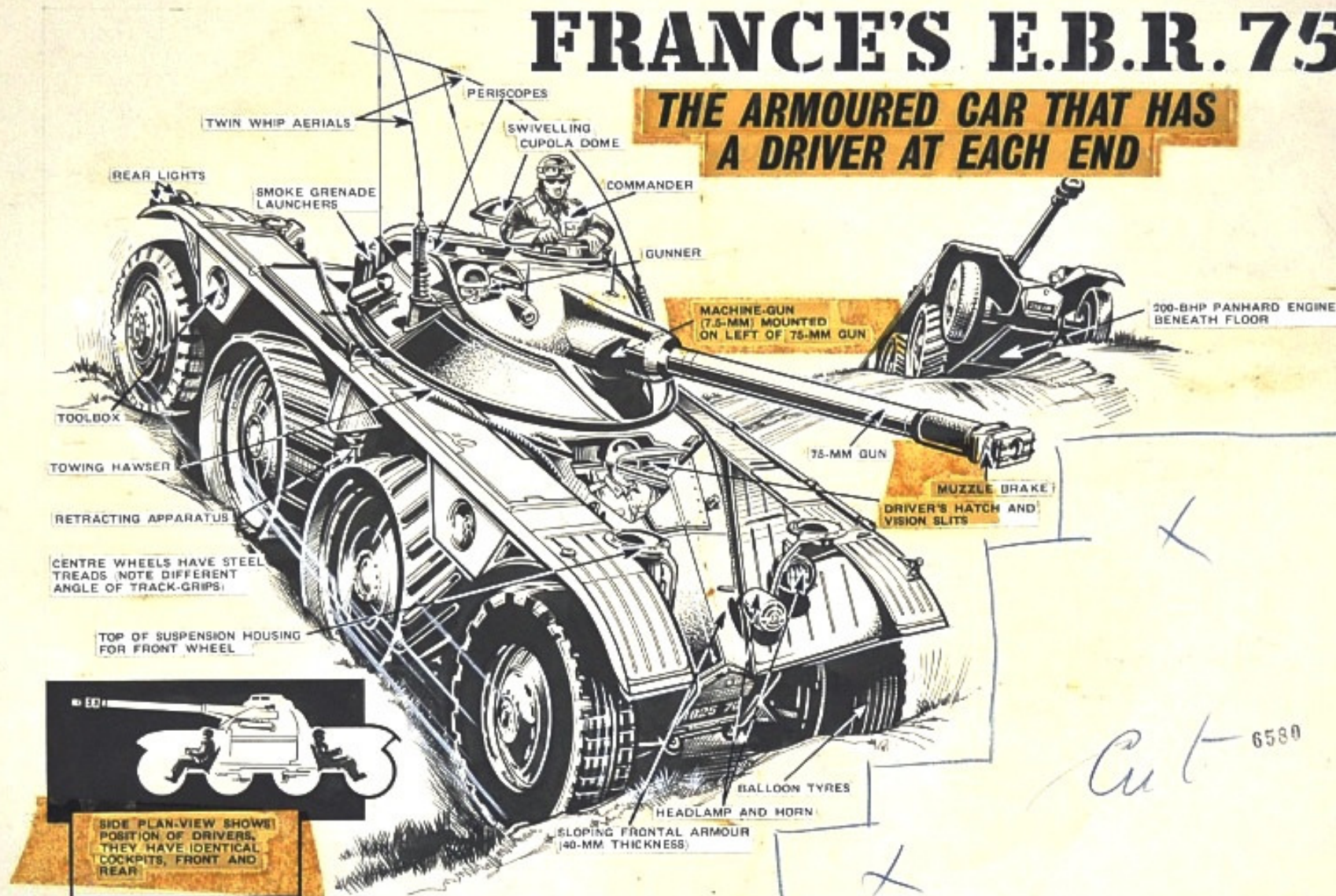
10"

The U.S. ARMY'S HOVERTRUCK



FRANCE'S E.B.R. 75

**THE ARMoured CAR THAT HAS
A DRIVER AT EACH END**



2/3 scale

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NOTE DATED
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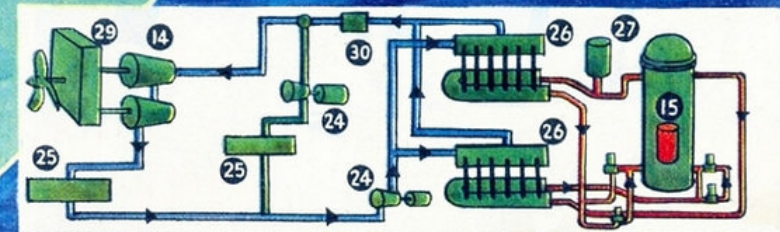
N.S. SAVANNAH

The United States Maritime administration has sponsored the building and fitting-out of the N.S. *Savannah*, the first atomic-powered merchant ship. Although expensive to build, the *Savannah* is the beginning of a new era in marine propulsion. In years to come, such vessels will be as common as oil-fired carriers of today. With a speed of 21 knots, this express freighter can carry her 110 crew and 60 passengers comfortably and silently to any port of the world without having to take on fuel oil. The travelling range is about 300,000 miles – equal to 150 trips across the Atlantic. The *Savannah* is 595 feet 6 inches long, and 78 feet wide. Displacement when loaded is 22,000 tons. The absence of the usual funnel gives this ship a clean, yacht-like appearance.



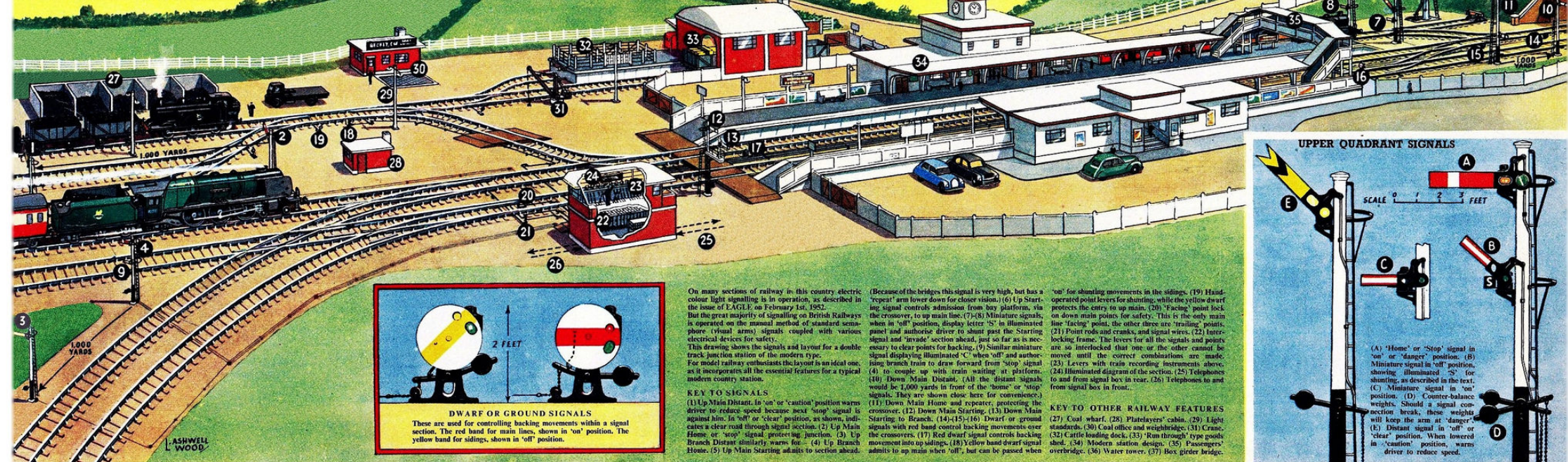
KEY TO NUMBERED PARTS

(1) Stern Bridge. (2) Radio mast. (3) Boat deck. (4) Waste-gas funnel and radar arm. (5) Air-conditioning exhaust. (6) Captain's quarters. (7) Officers' accommodation. (8) Cat-walk. (9) Passengers' lounge. (10) Reactor hatch. (11) Derrick mast. (12) Control rod mechanism. (13) Control centre. (14) Turbine. (15) Core. (16) Cargo hatch. (17) 'B' Deck. (18) 'C' Deck. (19) 'D' Deck. (20) Steel and redwood collision mat. (21) Concrete shielding. (22) Double-bottom tanks. (23) Reactor floor. (24) Turbo-generator. (25) Condenser. (26) Steam drums. (27) Pressurizer. (28) Passengers' accommodation. (29) Reduction gears. (30) Main steam separator.



Cornwall

BRITISH RAILWAYS STANDARD SIGNALLING





THE WORLD'S FIRST ATOMIC POWER STATION

The opening, by H.M. The Queen, of Calder Hall, Cumberland — the world's first full-scale atomic power station — will go down in history as a remarkable event for this country and for the whole world. This is a new age, and a new fuel, URANIUM — which constitutes a new source of power — is put to the service of mankind. Electricity produced from atomic power will flow into the national electricity grid system for the first time. In this special and exclusive EAGLE feature, we show the whole layout of Calder Hall 'A' Station. This consists of two huge atomic reactor

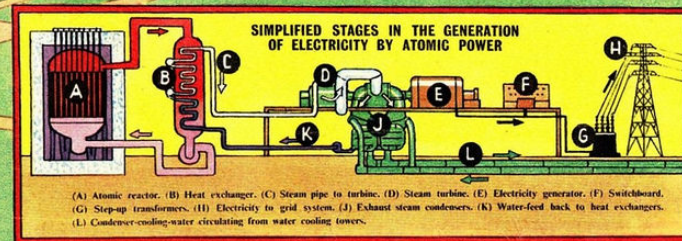
buildings, Nos. 1 and 2, each with their four 80 ft.-high heat exchanger towers, standing at either end of the turbine generating house. There are four turbines and generators. The 300 ft.-high cooling towers, of the shape familiar in most electric power stations, stand at the end. A second station, 'B', of similar design, is now being built end to end. In our special Christmas issue, next week, we shall show, in enlarged detail, how atomic power (nuclear fission) is harnessed to the generation of electricity at 11,000 volts, and how this reaches our homes.

KEY TO HOW IT OPERATES: (1) The reactor core of graphite moderator, with channels for uranium 235 fuel rods. These produce great heat. (2) Steel pressure vessel. (3) Reactor biological shield; 8ft.-thick concrete. (4) Control rods. (5) Fuel charging and discharging machines. (6) Reactor cooling-fans. (7) Cooling air chimneys. (8-8) Outlets for carbon dioxide gas, heated by passing through the reactor core. (9-9) Heat exchangers, or 'boilers'. Here the hot carbon dioxide gases produce steam in the exchanger tubes. (10) Steam pipes to turbines. (11) Return water feed pipes from turbine steam exhaust condensers. (12) Gas circulating blowers. (13) Cool gases entering reactor to be heated again. (14) Steam pipes from the four heat exchangers to turbines. (15) No. 2 reactor turbines. There are two turbines to each reactor. (16) 11,000-volt electricity generators. (17) Control room and switchboards. (18) 11,000-volt cables to transformers. Here the current is stepped up to 132,000 volts. (19) 132,000-volt overhead lines to the national grid network. (20) Turbine exhaust

steam condensers. Here the exhaust steam is condensed back into water and returned to the heat exchangers. (21) Condenser-cooling-water circulating from water cooling towers. (22) No. 1 reactor turbines. (23) Steam pipes from No. 1 reactor.

KEY TO WATER COOLING TOWERS: (24) Hot water from turbine condensers. (25) Hot water distributed into ducts and dripping over splash-boards. (26) Cooled water collecting well. (27) Cooled water returning to turbine condensers. (28) Cold air entering tower and cooling the water. (29) Passage of steam and air through the tower. 150,000,000 gallons of water pass through the towers per day; 3,000,000 gallons are lost through evaporation, and have to be made up from nearby rivers.

KEY TO BUILDINGS: (30) No. 1 water cooling tower. (31) No. 2 water cooling tower. (32) No. 1 reactor house. (33) No. 1 reactor heat exchangers. (34) Turbine house. Administration and workshop buildings are on the other side. (35) No. 2 reactor house. (36) Site of Calder Hall 'B' Station, now building.



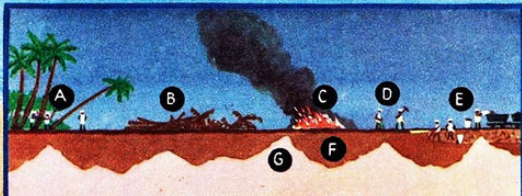
PHOSPHATES FROM A CORAL ISLAND IN THE PACIFIC OCEAN

When the Queen and the Duke of Edinburgh cross the Pacific Ocean in the Royal Ship *Gothic* (see last week's *Eagle*) they will pass many coral islands. Some of these islands contain phosphates, which are needed for agriculture. On the island of Maunu, shown here, millions of tons of natural phosphate rock have been discovered. It is easy to quarry, but to load it into ships at first presented a great problem. The island is surrounded by a great coral reef which extends 400 feet out to sea. Here the engineers came to the rescue and, as shown here, an ingenious system of conveyors and great swinging cantilever arms, stretching out over the edge of the reef, enable ships to be loaded at the rate of 1,000 tons an hour at all states of the tide. The ships are moored to buoys, but must keep steam up so that they can make out to sea in the event of a sudden gale.

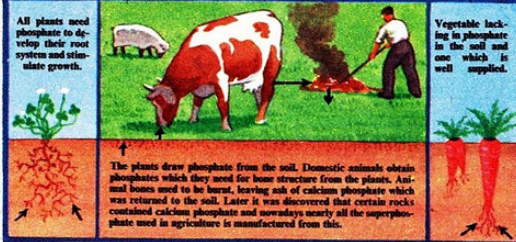
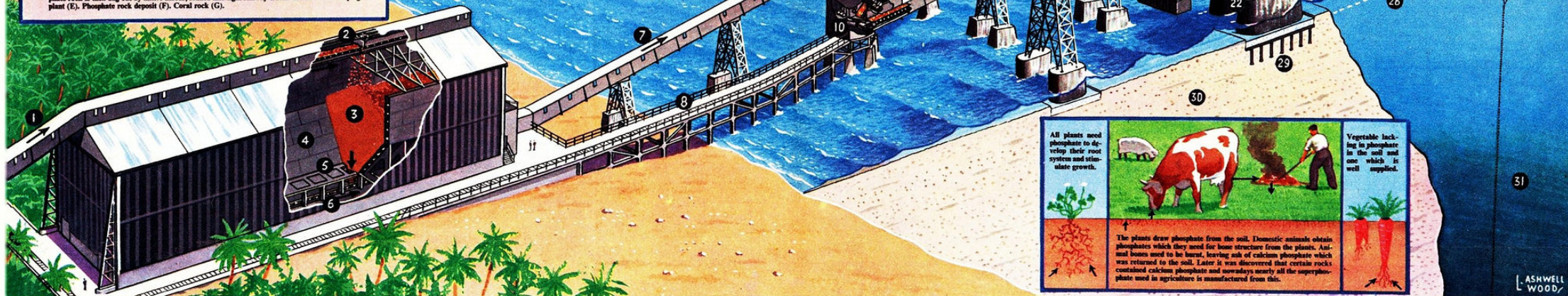
KEY TO OPERATIONS

(1) Main conveyor from drying plant. This conveyor comes right through the island forest. (2) Travelling carriage which tips off the phosphate rock at any desired point. (3) Phosphate rock in storage bin. (4) Storage bin, capable of holding 12,000 tons of phosphate rock, awaiting shipment. (5) Special doors through which the phosphate rock drops to the conveyor below when required. (6) Conveyor belt. (7) Conveyor to hopper. (8) Jetty with light railway for conveyor parts, etc. (9) Compensating hopper which divides the phosphate rock on to two conveyors. (10) Weighing machines. (11) Conveyor motor house. (12) Conveyor to cantilever arm. (13) Lattice structure for securing cantilever arm during a gale. (14) Position of cantilever arm when secured. (15) Swinging cantilever arm with conveyor inside. (16) Telescopic conveyor extension and delivery spout

to ship's hold. (17) Control box. The operator of each arm can watch the loading and is in control of all movements. (18) Securing structure for cantilever arm. (19) Conveyor to cantilever arm. (20) Phosphate rocks drop from one conveyor on to another above the pivot of the cantilever arm. (21) Motor house and 30 h.p. electric motor for swinging the arm. (22) Concrete piers. (23) Rack and pinion gear for swinging the arm. (24) Counterbalance weight. (25) Phosphate rocks drop on to telescopic conveyor. (26) Adjustable telescopic conveyor or delivery spout. This enables the correct positioning over the ship's holds. (27) One of several mooring buoys with deep anchorage. (28) Level of low tide. There is a heavy undercurrent here. (29) Concrete and steel foundations for piers. (30) Coral reef extending 400 feet out to sea. (31) Afloat drop to 180 fathoms.



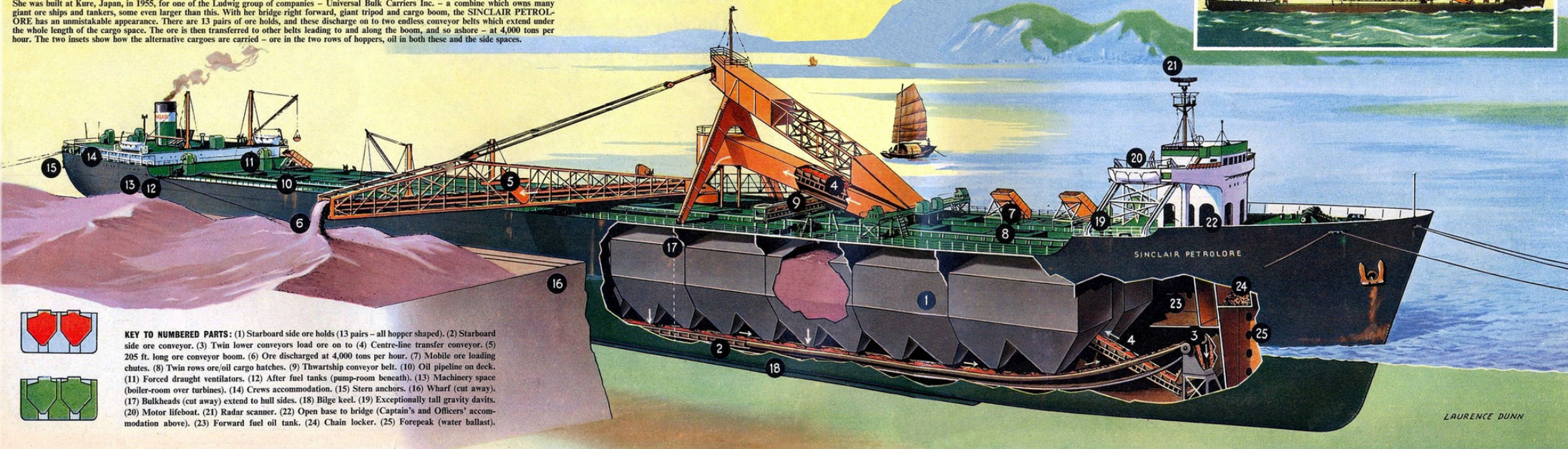
How the phosphate rock is excavated. First the trees are felled (A) and then piled up to wither with the coarse grass (B). They are then burnt (C). The overburden or top soil is removed (D). The phosphate rock is then dug out by native labour, loaded into light railway trucks and taken to a drying plant (E). Phosphate rock deposit (F). Coral rock (G).



THE WORLD'S LARGEST ORE/OIL CARRIER

The SINCLAIR PETROLORE, a monster dual purpose cargo carrier, is one of the most remarkable ships afloat. She can carry 67,300 tons of iron ore, or 56,300 tons of oil, and when she visited Fawley early in 1957 she was the largest tanker ever to dock in Great Britain, or even in Europe. Her length is 789 ft., breadth 106 ft. and load draught 40 ft. 3 ins. A single screw ship, she has two water tube boilers and geared turbines of 12,500 s.h.p. (the latter originally designed for a U.S. destroyer) which give a speed of 15 knots.

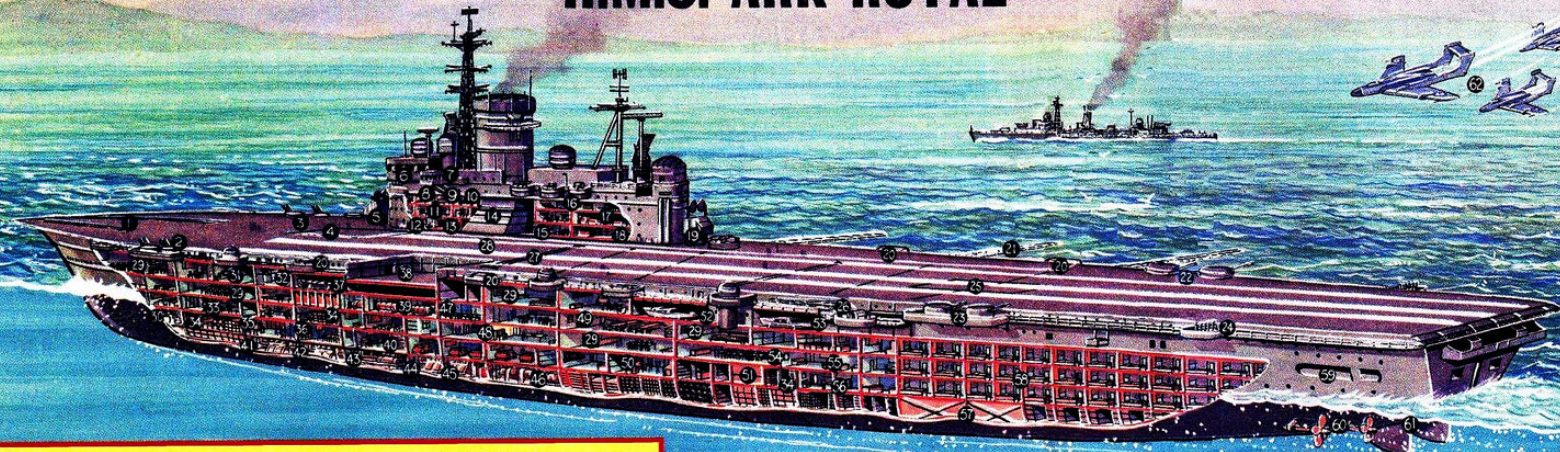
She was built at Kure, Japan, in 1955, for one of the Ludwig group of companies - Universal Bulk Carriers Inc. - a combine which owns many giant ore ships and tankers, some even larger than this. With her bridge right forward, giant tripod and cargo boom, the SINCLAIR PETROLORE has an unmistakable appearance. There are 13 pairs of ore holds, and these discharge on to two endless conveyor belts which extend under the whole length of the cargo space. The ore is then transferred to other belts leading to and along the boom, and so ashore - at 4,000 tons per hour. The two insets show how the alternative cargoes are carried - ore in the two rows of hoppers, oil in both these and the side spaces.



KEY TO NUMBERED PARTS: (1) Starboard side ore holds (13 pairs - all hopper shaped). (2) Starboard side ore conveyor. (3) Twin lower conveyors load ore on to (4) Centre-line transfer conveyor. (5) 205 ft. long ore conveyor boom. (6) Ore discharged at 4,000 tons per hour. (7) Mobile ore loading chutes. (8) Twin rows ore/oil cargo hatches. (9) Thwartship conveyor belt. (10) Oil pipeline on deck. (11) Forced draught ventilators. (12) After fuel tanks (pump-room beneath). (13) Machinery space (boiler-room over turbines). (14) Crews accommodation. (15) Stern anchors. (16) Wharf (cut away). (17) Bulkheads (cut away) extend to hull sides. (18) Bilge keel. (19) Exceptionally tall gravity davits. (20) Motor lifeboat. (21) Radar scanner. (22) Open base to bridge (Captain's and Officers' accommodation above). (23) Forward fuel oil tank. (24) Chain locker. (25) Forepeak (water ballast).

LAURENCE DUNN

H.M.S. ARK ROYAL



Britain's latest aircraft-carrier, H.M.S. *Ark Royal*, is the fourth ship in the Royal Navy to bear the name. The first, of 800 tons, built by Sir Walter Raleigh, was launched in 1587 and was the flagship that sailed out to challenge the Spanish Armada. The new 36,800 ton *Ark Royal* is equipped to weather a nearby atomic explosion, and also to launch an atomic attack herself. She can carry 100 aircraft and a crew of 2,200 officers and men.

KEY TO NUMBERS

(1) Steam catapults. (2)-(3) 4.5 inch dual-purpose guns. (4) Aircraft lift. (5) Director tower. (6) Bridge. (7) Flying Commander's cabin. (8) Captain's sea-cabin. (9) Navigation officers' sea-cabin. (10) Control room. (11) Executive officers' sea-cabins. (12) Planning rooms. (13) Switch room. (14) Boiler uptakes. (15) Briefing room. (16) Operations rooms. (17) Fan machinery. (18) Ready room. (19) Fire-control tower. (20) Bofors guns.

(21) Radio masts, lowered. (22)-(23) 4.5 inch dual-purpose guns. (24) Deck-landing controller. (25) After aircraft lift. (26) Crane. (27) Arrestor-net, lowered. (28) Angled flight-deck. (29) Mess. (30) Laundry. (31) Air workshops. (32) Showers. (33) Hospital. (34) Stores. (35) Forward remote-control room. (36) Mechanics' mess. (37) 32-foot cutter. (38) Deck-edge lift. (39) Lift machinery. (40) Engineers' offices. (41)-(42) Forward boiler-rooms. (43) Forward port engine-room. (44)-(45) After port boiler-rooms. (46) After port engine-room. (47) Wash-place. (48) Recreation rooms. (49) Dining hall. (50) After remote-control room. (51) Prison. (52)-(53) 36-foot speedboats. (54) Dining hall. (55) Ante-room. (56) Captain's lower office. (57) Fresh-water tanks. (58) Officers' cabins. (59) Quarter deck. (60) Port twin propellers. (61) Twin rudders. (62) D.H.110 two-seat, all-weather, strike aircraft of the type which are scheduled to operate from the *Ark Royal* in the near future.

ONE OF ARK ROYAL'S REMOTE-CONTROL ROOMS

These rooms are hermetically sealed and air-conditioned, to enable the crew to control the engines and boilers while the ship speeds out of a contaminated area during an atomic attack. Meanwhile, spray nozzles wash the exposed deck.

KEY TO NUMBERS

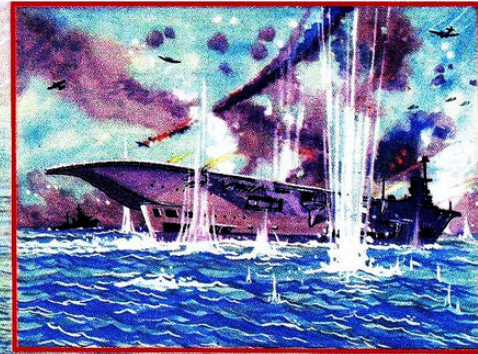
(63) Auxiliary air bottles. (64) Steam-pressure gauges. (65) Batteries. (66) Starters for pump motors. (67) Pump motors. (68) Engine-room controls. (69) Boiler-room controls. (70) Engineer-officer in command.



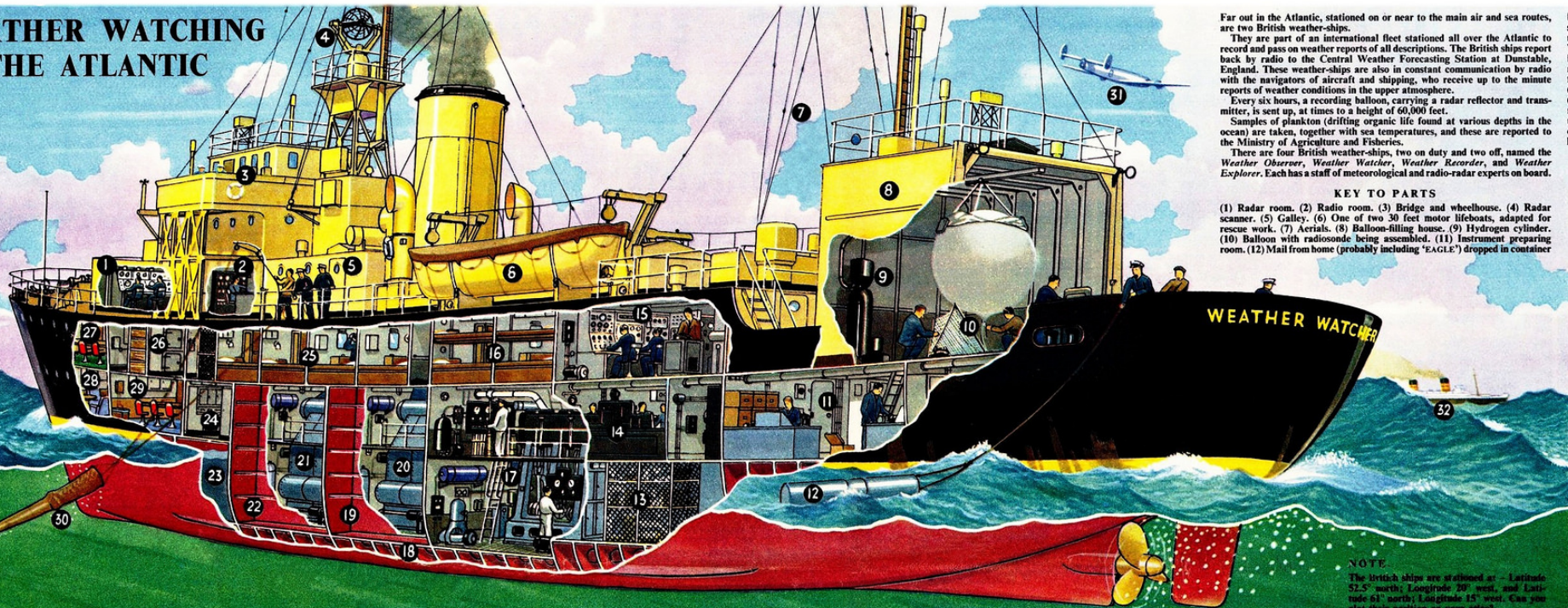
THE 'ARK ROYAL' OF WORLD WAR II

The predecessor of the latest *Ark Royal* had a short but active career. During World War II, her exploits became almost legendary. On many occasions, she was the target of enemy bombers, and the great ship is seen here in the midst of such an attack, made by squadrons of Italian aircraft.

During this, she at one time disappeared behind a wall of water, flung up by thirty bombs falling around her, some as near as twenty yards away! Eye-witnesses of the action thought she had gone, but she emerged with all her guns blazing 'like a great angry bee'. Again and again, the enemy claimed to have sunk her at different periods during the war, only for her to appear in yet another action, and so prove the falsehood of their propaganda! Very soon after the outbreak of war, she was attacked by three Flying Boats and five Heinkel bombers, as she returned to her base in Scotland. A Heinkel scored a 'near miss' with a 1,000 lb. bomb, but a smoke-screen that had been put up prevented the pilot from seeing exactly what had happened. However, evidently the enemy thought they had sunk her; their radio put out this fact, and the Lance-Corporal pilot of the Heinkel received the Iron Cross and was promoted to Lieutenant in recognition of his 'achievement'. This was the first of many such claims. Despite the numerous attempts to destroy her from the air, she met her end, strange to say, by the action of a German submarine. She was torpedoed about 3.30 on the afternoon of 13th November, 1941, some thirty miles east of Gibraltar. Her Captain thought she might be got to the great naval base, and tugs steamed to her aid. She remained afloat for over twelve hours then, on the following day, despite all efforts to tow her to safety, she heeled over and sank 'like a tired child'. Her aeroplanes went down with her, and all hands, with one exception, were saved - no less than 1,600 officers and men. Today, her gallant spirit lives on, and her famous name again rides the ocean in Britain's latest and greatest aircraft-carrier - H.M.S. *Ark Royal*!



WEATHER WATCHING IN THE ATLANTIC



Far out in the Atlantic, stationed on or near to the main air and sea routes, are two British weather-ships.

They are part of an international fleet stationed all over the Atlantic to record and pass on weather reports of all descriptions. The British ships report back by radio to the Central Weather Forecasting Station at Dunstable, England. These weather-ships are also in constant communication by radio with the navigators of aircraft and shipping, who receive up to the minute reports of weather conditions in the upper atmosphere.

Every six hours, a recording balloon, carrying a radar reflector and transmitter, is sent up, at times to a height of 60,000 feet.

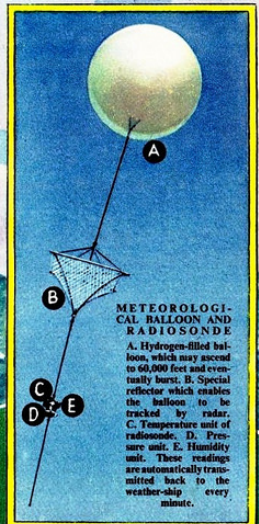
Samples of plankton (drifting organic life found at various depths in the ocean) are taken, together with sea temperatures, and these are reported to the Ministry of Agriculture and Fisheries.

There are four British weather-ships, two on duty and two off, named the *Weather Observer*, *Weather Watcher*, *Weather Recorder*, and *Weather Explorer*. Each has a staff of meteorological and radio-radar experts on board.

KEY TO PARTS

(1) Radar room. (2) Radio room. (3) Bridge and wheelhouse. (4) Radar scanner. (5) Galley. (6) One of two 30 feet motor lifeboats, adapted for rescue work. (7) Aerials. (8) Balloon-filling house. (9) Hydrogen cylinder. (10) Balloon with radiosonde being assembled. (11) Instrument preparing room. (12) Mail from home (probably including 'EAGLE') dropped in container.

by Coastal Command aircraft. (13) Engineers' store. (14) Meteorological office. (15) Transmitter room. (16) Officers' quarters. (17) Engine room. Triple expansion steam engine. (18) Double bottom. (19) Side oil fuel tank. (20) After boiler room. (21) Forward boiler room. (22) Side oil fuel tank. (23) Oil fuel tank. (24) Officers' pantry. (25) Officers' quarters. (26) Provision store. (27) Petty officers' mess. (28) Officers' smoke room. (29) Officers' mess. (30) Plankton being taken from the sea. (31) Coastal Command mail carrier. (32) Radio weather reports to Atlantic liners.



NOTE

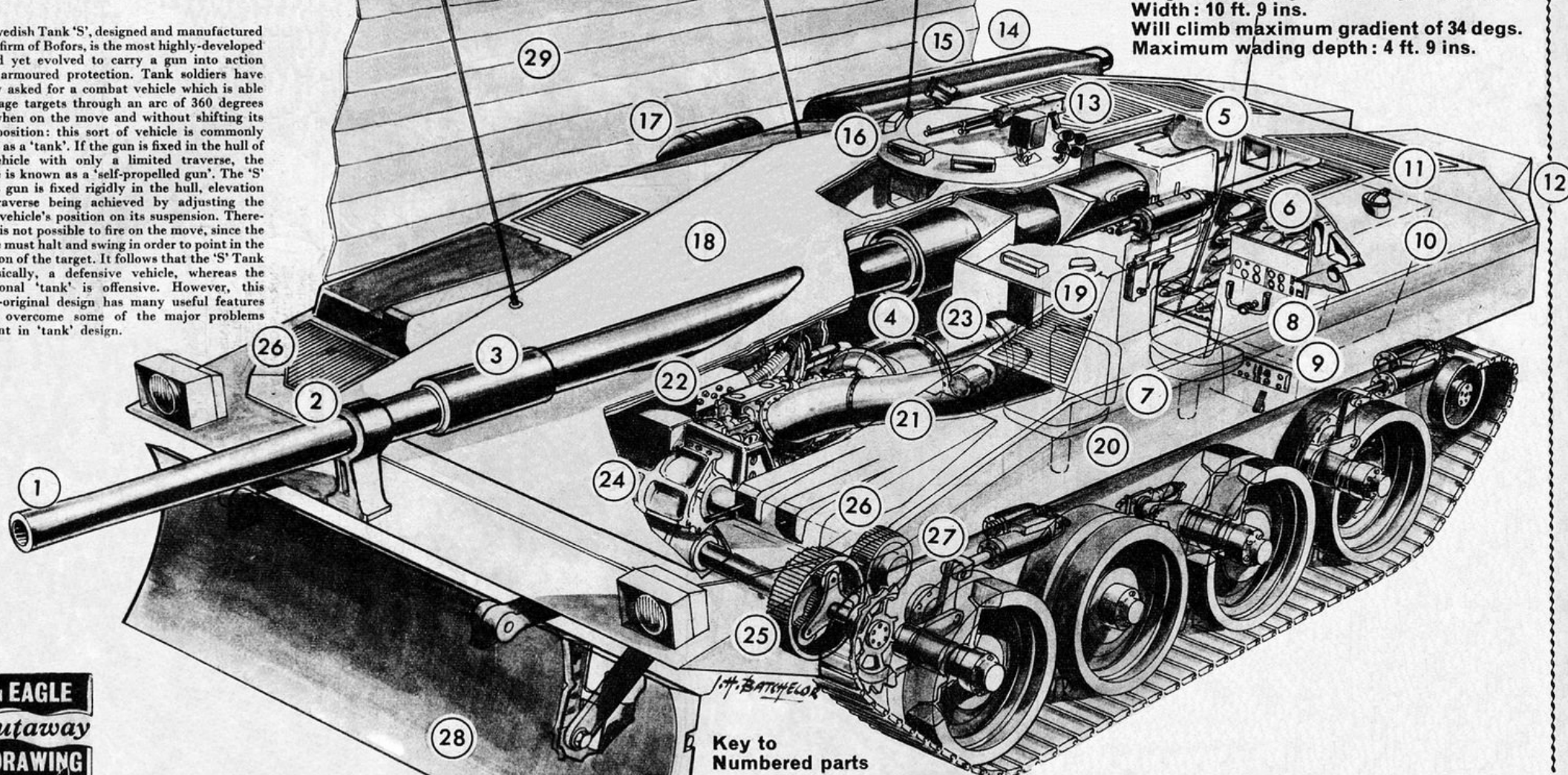
The British ships are stationed at: - Latitude 52.5° north; Longitude 20° west, and Latitude 61° north; Longitude 15° west. Can you plot their position on your atlas?

THE WORLD'S MOST ORIGINAL TANK

The Swedish Tank 'S', designed and manufactured by the firm of Bofors, is the most highly-developed method yet evolved to carry a gun into action under armoured protection. Tank soldiers have usually asked for a combat vehicle which is able to engage targets through an arc of 360 degrees even when on the move and without shifting its main position: this sort of vehicle is commonly known as a 'tank'. If the gun is fixed in the hull of the vehicle with only a limited traverse, the vehicle is known as a 'self-propelled gun'. The 'S' Tank's gun is fixed rigidly in the hull, elevation and traverse being achieved by adjusting the whole vehicle's position on its suspension. Therefore it is not possible to fire on the move, since the vehicle must halt and swing in order to point in the direction of the target. It follows that the 'S' Tank is, basically, a defensive vehicle, whereas the traditional 'tank' is offensive. However, this highly-original design has many useful features which overcome some of the major problems inherent in 'tank' design.

SPECIFICATIONS:

Crew: 3.
Length with gun: 28 ft. 8 ins.
Height excluding machine-gun: 6 ft. 3 ins.
Width: 10 ft. 9 ins.
Will climb maximum gradient of 34 degs.
Maximum wading depth: 4 ft. 9 ins.



Key to Numbered parts

(1) British 105 mm. high-velocity gun. (2) Barrel 'whip' preventer. Loose fitting to facilitate recoil of 10.6 ins. (3) Fume extractor which traps hot gases as gun is fired and then ejects them through angled holes, blowing much of the smoke clear of barrel. (4) Barrel mounts and supports. This gun does not traverse or elevate, so mounting problems are very much reduced. Bushes round barrel slide inside a tube secured to vehicle body. (5, 6) Vertical moving breach. This gun is fully automatic when loading. When gun is fired, recoil operates this small square door, ejecting empty case and smoke out of vehicle and then closing door. H.E. or armour-piercing shells are stacked, 25 of each on either side of breach in angled magazine, which itself is loaded in five minutes from door at rear of vehicle. When the commander pushes the selection button for either H.E. or armour-piercing, a shell from one side or other runs sideways on to the loading tray at the bottom of the magazine. As soon as it is on the tray, this automatically runs up until the shell is in line with the chamber. A small trip runs the shell forward into the breach and then runs back, and the tray returns to the magazine apertures. The breach is, in the meantime, automatically closed and the gun ready for firing. The top five rounds in the magazine shown are smoke shells which rear-facing radio operator/engineer can reach through a hole in the bulkhead. On a command, he can fuse these for the correct range and get on to the loading tray from their high position in the magazine by using the hand-operated hydraulic system on the side of the breach. If there is already a shell in the breach, this is ejected or fired to clear the way for the smoke shell. (7) Rear-facing

radio operator/engineer's seat. In an emergency, he can drive the vehicle rearwards by using the simple handles (8) and accelerator below radio (9). He has a rear-facing and flank periscope to see through. (10) Dotted line shows extent of port-side magazine. (11) Fuel filler cap for turbine. (12) Crew kit panniers. (13) British 7.62 mm. machine-gun. When fixed in travelling position, it can be fired from inside vehicle using graticule in periscope for aiming. (14) Exhaust system for multi-fuel engine. (15) Four smoke-grenade dischargers on either side of commander's cupola or hatch. (16) Three periscopes for use by commander. (17) External fire extinguisher. (18) Shallow sloping armoured front gives good shell penetration protection and low silhouette. (19) Periscopes for driver/gunner. (20) Forward-facing seat below periscopes for driver/gunner. (21) Exhaust system for turbine engine. This is an American Boeing 502, 330 h.p. turbine engine coupled to a British 240 h.p. Rolls-Royce K.60 multi-fuel engine (22). (23) Aft of these coupled engines is the hydraulic system and pump centre. (24) Gearbox and track selection clutches and brakes. (25) Final drive through 'planet' gears. (26) Two fixed 7.62 mm. machine-guns. (27) Hydro-pneumatic independent suspension is used in a unique manner to elevate gun. Elevation and depression is managed solely by raising and lowering front and rear of vehicle. (28) Bulldozer blade can be fitted to all vehicles, but generally one in five is fitted. This is not a hydraulically-operated unit. It is used to dig defensive positions in open country and clear tracks for following support vehicles. (29) Part of swimming screen shown in raised position.

AN EAGLE
cutaway
DRAWING

12 1/2° MAX.
ELEVATION

10° MAX.
DEPRESSION

Britain's Largest Oil-Tanker

AN EAGLE
cutaway
DRAWING

The oil tanker plays a very important part in world shipping. Tankers comprise over a quarter of all merchant ship tonnage. Oil is now the most important cargo in world trade.

The largest British-built tanker to come into service is the *British Mariner*, of 71,018 tons. She was built at John Brown's Clydebank yard for B.P.

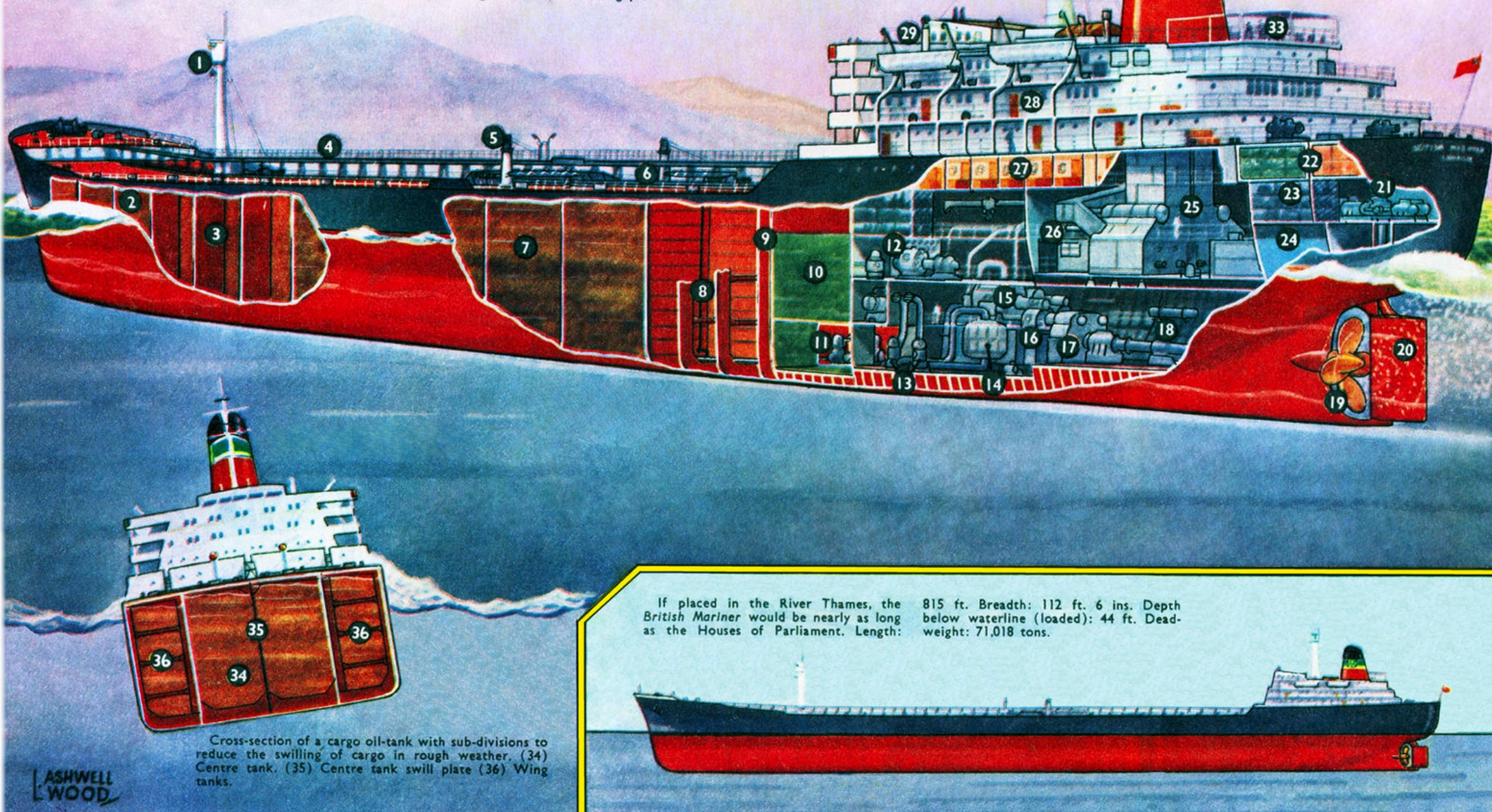
In her 12 cargo tanks, she can carry 19 million gallons of crude oil on one voyage!

The ship has her whole superstructure aft. The distance along the footway from the bridge to the forecastle head is 661 ft. The engine output of 20,000 h.p. gives her a service speed of 15½ knots when loaded.

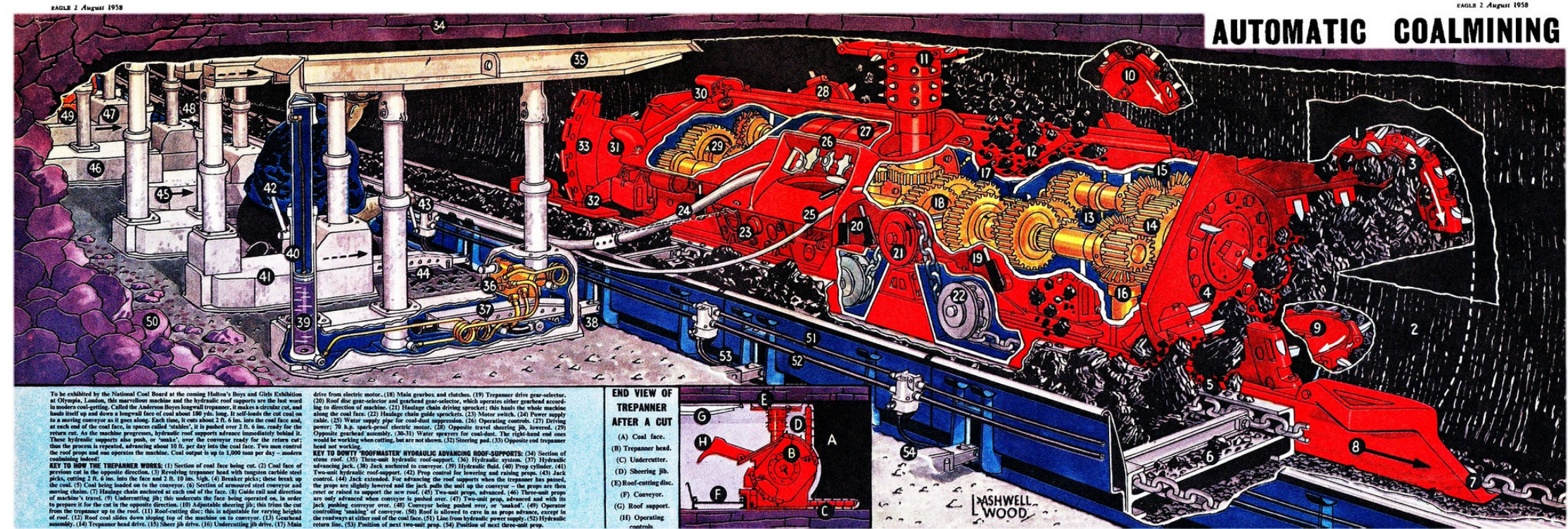
KEY TO NUMBERED PARTS

(1) Foremast and crow's nest. (2) Forward oil cargo tanks. (3) Three wing tanks, either side, used for sea water ballast. (4) Footbridge or

catwalk. (5) Crane for handling pipe lines. (6) Oil cargo hatches and tank valve controls on deck. (7) Oil cargo wing tanks. (8) Cutaway to show construction of cargo tanks. There are 12 tanks sub-divided into 24 wing tanks. (9) Cofferdam space to separate the tanker fuel from the cargo. (10) Boiler oil tanks. (11) Cargo pumps. (12) Switch-board and turbo-generator. (13) Sea water circulating pipes for condensers. (14) Used steam condensers. (15) High and low pressure steam turbines. (16) First reduction gearing. (17) Main reduction gearing. (18) Propeller shaft. (19) Singer, four-bladed propeller. (20) Balanced rudder. (21) Steering gear. (22) Refrigerated stores. (23) Normal stores. (24) Fresh water tanks. (25) Twin, oil-fired boilers and funnel uptakes. (26) Sound-insulated room for automatic control of all machinery. (27) Crew's quarters of a very high standard. (28) Officers' quarters. (29) Navigating bridge. (30) Streamlined main mast. (31) Radar scanner. (32) Streamlined funnel with ventilation grilles. (33) Swimming pool.



AUTOMATIC COALMINING



To be exhibited by the National Coal Board at the coming Hulton's Boys and Girls Exhibition at Olympia, London, this marvellous machine and the hydraulic roof supports are the last word in modern coal-mining. Called the Anderson Boys longwall trepanner, it makes a circular cut, and hauls itself up and down a longwall face of coal about 180 yds. long. It self-loads the cut coal on to a moving conveyor as it goes along. Each time, it cuts about 2 ft. 6 ins. into the coal face and, at each end of the coal face, in spaces called 'stables', it is pushed over 2 ft. 6 ins. ready for the return cut. As the machine progresses, hydraulic roof supports advance immediately behind it. These hydraulic supports also push, or 'walk', over the conveyor ready for the return cut; thus the process is repeated, advancing about 10 ft. per day into the coal face. Two men control the roof props and one operates the machine. Coal output is up to 1,000 tons per day - modern coalmining indeed!

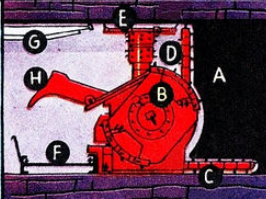
KEY TO HOW THE TREPPANNER WORKS: (1) Section of coal face being cut. (2) Coal face of previous cut in the opposite direction. (3) Revolving trepanner head with tungsten carbide steel picks, cutting 2 ft. 6 ins. into the face and 2 ft. 10 ins. high. (4) Breaker picks; these break up the coal. (5) Coal being loaded on to the conveyor. (6) Section of armoured steel conveyor and moving chains. (7) Haulage chain guide sprockets. (8) Guide rail and direction of machine's travel. (9) Undercutting jib; this undercuts the face being operated on, in order to prepare it for the cut in the opposite direction. (10) Adjustable shearing jib; this trims the cut from the trepanner up to the roof. (11) Roof-cutting disc; this is adjustable for varying heights of roof. (12) Roof coal slides down sloping top of the machine. (13) Gearhead assembly. (14) Trepanner head drive. (15) Shear jib drive. (16) Undercutting jib drive. (17) Main

drive from electric motor. (18) Main gearbox and clutches. (19) Trepanner drive gear-selector. (20) Roof disc gear-selector and gearhead chain driving sprocket; this hauls the whole machine along the coal face. (21) Haulage chain guide sprockets. (22) Motor switch. (23) Power supply cable. (24) Water supply pipe for coal-dust suppression. (25) Operating controls. (26) Driving power; 70 h.p. spark-proof electric motor. (27) Opposite travel shearing jib, lowered. (28) Opposite gearhead assembly. (29-31) Water sprayers for coal-dust. The right-hand end ones would be working when cutting, but are not shown. (32) Steering pad. (33) Opposite end trepanner head not working.

KEY TO DOWTY 'ROOFMASTER' HYDRAULIC ADVANCING ROOF-SUPPORTS: (34) Section of stone roof. (35) Three-unit hydraulic roof-support. (36) Hydraulic system. (37) Hydraulic advancing jack. (38) Jack anchored to conveyor. (39) Hydraulic fluid. (40) Prop cylinder. (41) Two-unit hydraulic roof-support. (42) Prop control for lowering and raising props. (43) Jack control. (44) Jack extended. For advancing the roof supports when the trepanner has passed, the props are slightly lowered and the jack pulls the unit up the conveyor - the props are then reset or raised to support the new roof. (45) Two-unit props, advanced. (46) Three-unit props are only advanced when conveyor is pushed over. (47) Two-unit prop, advanced and with its jack pushing conveyor over. (48) Conveyor being pushed over, or 'snaked'. (49) Operator controlling 'snaking' of conveyor. (50) Roof is allowed to cave in as props advance, except in the roadways at either end of the coal face. (51) Line from hydraulic power supply. (52) Hydraulic return line. (53) Position of next two-unit prop. (54) Position of next three-unit prop.

END VIEW OF TREPPANNER AFTER A CUT

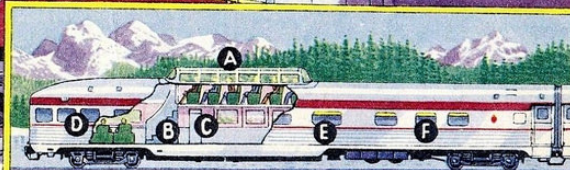
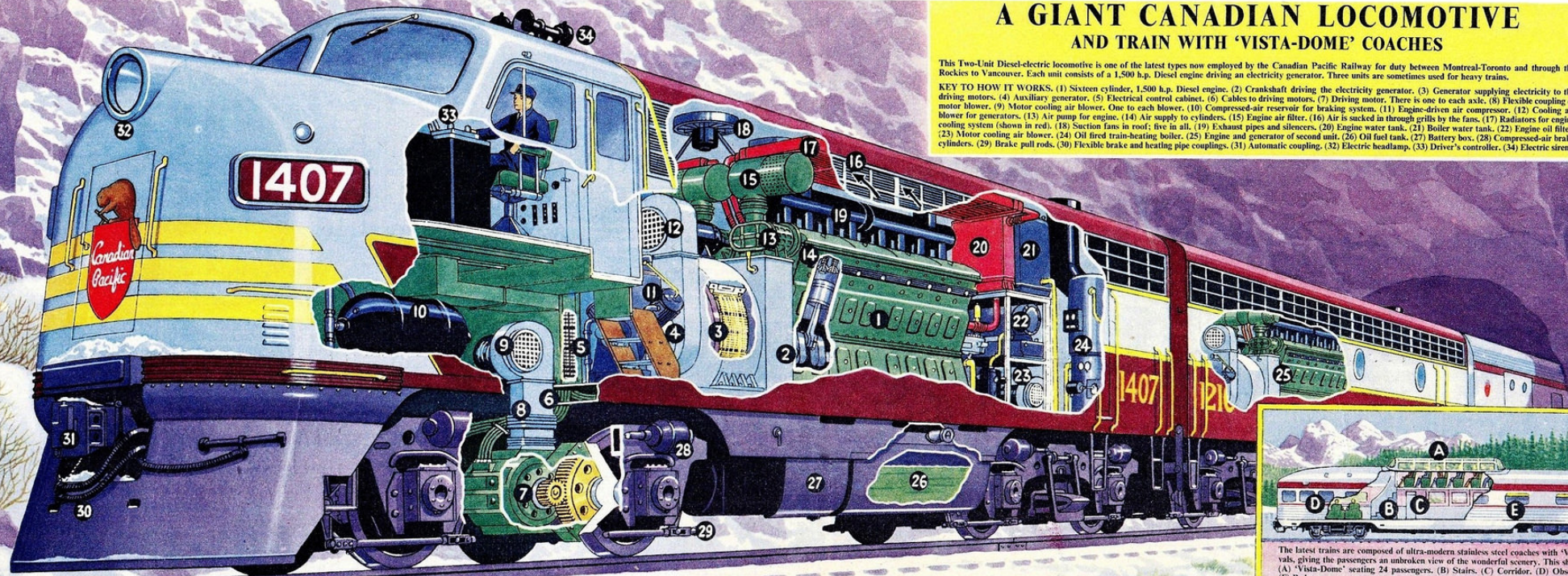
- (A) Coal face.
- (B) Trepanner head.
- (C) Undercutter.
- (D) Shearing jib.
- (E) Roof-cutting disc.
- (F) Conveyor.
- (G) Roof support.
- (H) Operating controls.



A GIANT CANADIAN LOCOMOTIVE AND TRAIN WITH 'VISTA-DOME' COACHES

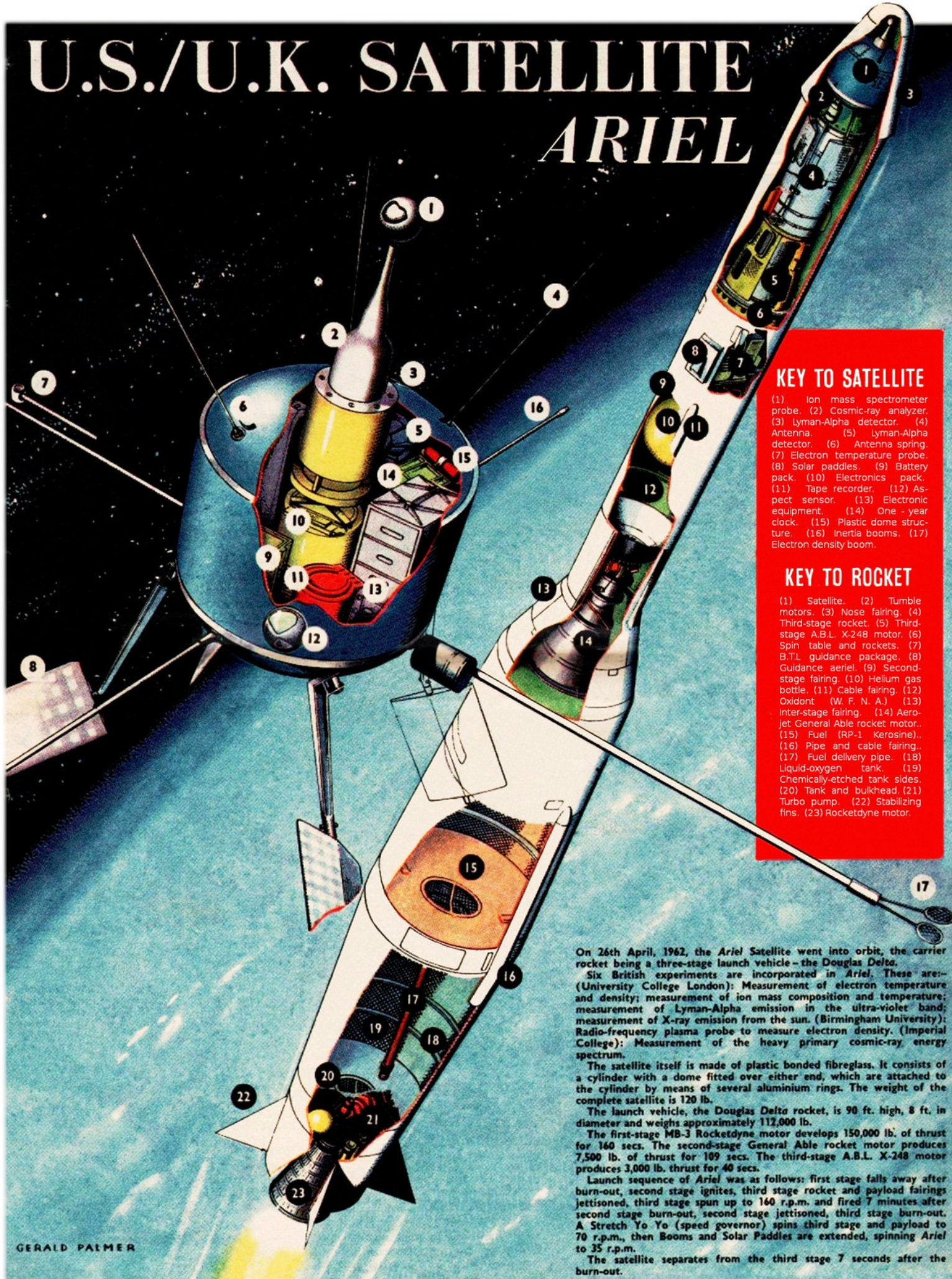
This Two-Unit Diesel-electric locomotive is one of the latest types now employed by the Canadian Pacific Railway for duty between Montreal-Toronto and through the Rockies to Vancouver. Each unit consists of a 1,500 h.p. Diesel engine driving an electricity generator. Three units are sometimes used for heavy trains.

KEY TO HOW IT WORKS. (1) Sixteen cylinder, 1,500 h.p. Diesel engine. (2) Crankshaft driving the electricity generator. (3) Generator supplying electricity to the driving motors. (4) Auxiliary generator. (5) Electrical control cabinet. (6) Cables to driving motors. (7) Driving motor. There is one to each axle. (8) Flexible coupling of motor blower. (9) Motor cooling air blower. One to each blower. (10) Compressed-air reservoir for braking system. (11) Engine-driven air compressor. (12) Cooling air blower for generators. (13) Air pump for engine. (14) Air supply to cylinders. (15) Engine air filter. (16) Air is sucked in through grills by the fans. (17) Radiators for engine cooling system (shown in red). (18) Suction fans in roof; five in all. (19) Exhaust pipes and silencers. (20) Engine water tank. (21) Boiler water tank. (22) Engine oil filter. (23) Motor cooling air blower. (24) Oil fired train-heating boiler. (25) Engine and generator of second unit. (26) Oil fuel tank. (27) Battery box. (28) Compressed-air brake cylinders. (29) Brake pull rods. (30) Flexible brake and heating pipe couplings. (31) Automatic coupling. (32) Electric headlamp. (33) Driver's controller. (34) Electric sirens.



The latest trains are composed of ultra-modern stainless steel coaches with 'Vista-Dome' coaches placed at intervals, giving the passengers an unbroken view of the wonderful scenery. This shows the observation car at the rear. (A) 'Vista-Dome' seating 24 passengers. (B) Stairs. (C) Corridor. (D) Observation lounge. (E) Drawing room. (F) Bedrooms.

U.S./U.K. SATELLITE ARIEL



KEY TO SATELLITE

(1) Ion mass spectrometer probe. (2) Cosmic-ray analyzer. (3) Lyman-Alpha detector. (4) Antenna. (5) Lyman-Alpha detector. (6) Antenna spring. (7) Electron temperature probe. (8) Solar paddles. (9) Battery pack. (10) Electronics pack. (11) Tape recorder. (12) Aspect sensor. (13) Electronic equipment. (14) One-year clock. (15) Plastic dome structure. (16) Inertia booms. (17) Electron density boom.

KEY TO ROCKET

(1) Satellite. (2) Tumble motors. (3) Nose fairing. (4) Third-stage rocket. (5) Third-stage A.B.L. X-248 motor. (6) Spin table and rockets. (7) B.T.L. guidance package. (8) Guidance aerial. (9) Second-stage fairing. (10) Helium gas bottle. (11) Cable fairing. (12) Oxidant (W. F. N. A.). (13) Inter-stage fairing. (14) Aerojet General Able rocket motor. (15) Fuel (RP-1 Kerosine). (16) Pipe and cable fairing. (17) Fuel delivery pipe. (18) Liquid-oxygen tank. (19) Chemically-etched tank sides. (20) Tank and bulkhead. (21) Turbo pump. (22) Stabilizing fins. (23) Rocketdyne motor.

On 26th April, 1962, the Ariel Satellite went into orbit, the carrier rocket being a three-stage launch vehicle—the Douglas Delta.

Six British experiments are incorporated in Ariel. These are: (University College London): Measurement of electron temperature and density; measurement of ion mass composition and temperature; measurement of Lyman-Alpha emission in the ultra-violet band; measurement of X-ray emission from the sun. (Birmingham University): Radio-frequency plasma probe to measure electron density. (Imperial College): Measurement of the heavy primary cosmic-ray energy spectrum.

The satellite itself is made of plastic bonded fibreglass. It consists of a cylinder with a dome fitted over either end, which are attached to the cylinder by means of several aluminium rings. The weight of the complete satellite is 120 lb.

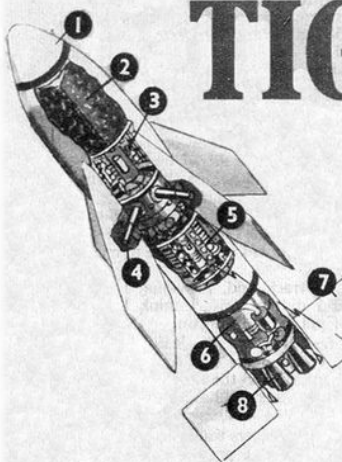
The launch vehicle, the Douglas Delta rocket, is 90 ft. high, 8 ft. in diameter and weighs approximately 112,000 lb.

The first-stage MB-3 Rocketdyne motor develops 150,000 lb. of thrust for 160 secs. The second-stage General Able rocket motor produces 7,500 lb. of thrust for 109 secs. The third-stage A.B.L. X-248 motor produces 3,000 lb. thrust for 40 secs.

Launch sequence of Ariel was as follows: first stage falls away after burn-out, second stage ignites, third stage rocket and payload fairings jettisoned, third stage spun up to 160 r.p.m. and fired 7 minutes after second stage burn-out, second stage jettisoned, third stage burn-out. A Stretch Yo Yo (speed governor) spins third stage and payload to 70 r.p.m., then Booms and Solar Paddles are extended, spinning Ariel to 35 r.p.m.

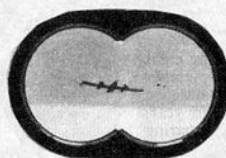
The satellite separates from the third stage 7 seconds after the burn-out.

TIGERCAT—"FIRE ONE!"

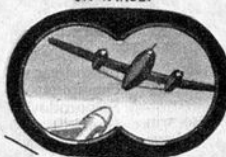


KEY TO THE TIGERCAT MISSILE

(1) Fuse head. (2) High-explosive warhead. (3) Electronic control pack. (4) Movable wings for control of pitch and direction. (5) Electronic guidance pack which receives the aimer's commands via a radio link transmitter. (6) Rocket motor. (7) Fixed fins. (8) Exhaust nozzles.



ON TARGET

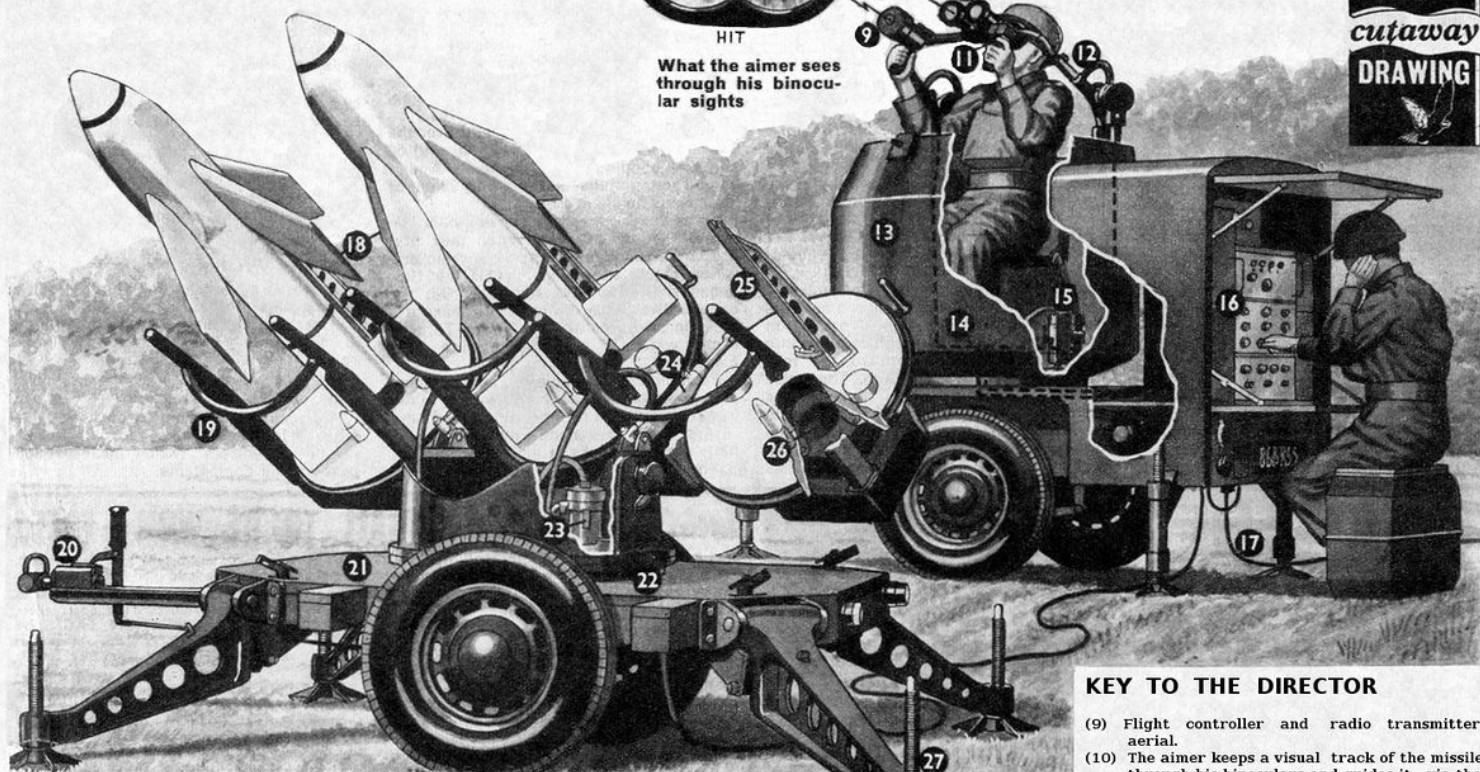


CLOSING



HIT

What the aimer sees through his binocular sights



KEY TO THE DIRECTOR

- (9) Flight controller and radio transmitter aerial.
- (10) The aimer keeps a visual track of the missile through his binoculars and guides it, via the flight controller, to its target.
- (11) Firing trigger.
- (12) Elevating arm.
- (13) Revolving director bin.
- (14) Cables of electro-hydraulic system to computer.
- (15) Electric motor drive to bin turntable.
- (16) All motions and missile launches are controlled by a computer in charge of the control officer.
- (17) Power supply from towing vehicle.

KEY TO MISSILE LAUNCHER

- (18) Tigercat missiles ready for launching.
- (19) Loading ramps.
- (20) Towing arm.
- (21) Launcher platform.
- (22) Turntable.
- (23) Hydraulic motor drive to turntable. This trains the missiles horizontally through 180 degrees.
- (24) Hydraulic elevating jack through 60 degrees.
- (25) Missile support.
- (26) Firing apparatus.
- (27) Ground support leg, extended.

Looking like giant milk bottles in their weatherproof casings, the Tigercat launcher and its Land-Rover towing vehicle followed by the director towing vehicle with power supply generator



ASHWELL
WOOD

A SUBMARINE 'MOTHER SHIP'

This is another drawing in our series of ships of the Royal Navy and shows one whose work plays an important part in keeping our submarine service at a high pitch of efficiency. When a submarine returns from patrol its 'mother ship', or depot ship as it is called, not only provides a home from home for the crew, but takes charge of their boat and restores it to perfect condition. Besides rest rooms and comfortable quarters, the submarine crews have their own mess rooms and lockers and are able to enjoy home comforts for the few days required to recharge and refuel their craft. On board the depot ship there are some five hundred skilled naval craftsmen who, in up-to-date workshops, are able to make or repair any part of the submarine that may require attention and refuel her ready for the next patrol. The ship shown here is H.M.S. *Maidstone*, which has a displacement of 11,815 tons fully loaded, is 574 feet long and armed against air attack.

KEY TO ABOVE DECKS

(1) Forward twin 4.5 in. high angle guns. (2) Chart house and navigating bridge. (3) Forward fire-control tower. (4) Light anti-aircraft guns. (5) 6-ton electric crane (one each side). (6) Submarine crew's rest deck. (7) Multiple 2-pounder anti-aircraft guns. (8) Midships twin 4.5 in. guns. (9) After fire-control tower. (10) 10-ton electric crane. (11) 4-in. submarine type gun for training purposes.

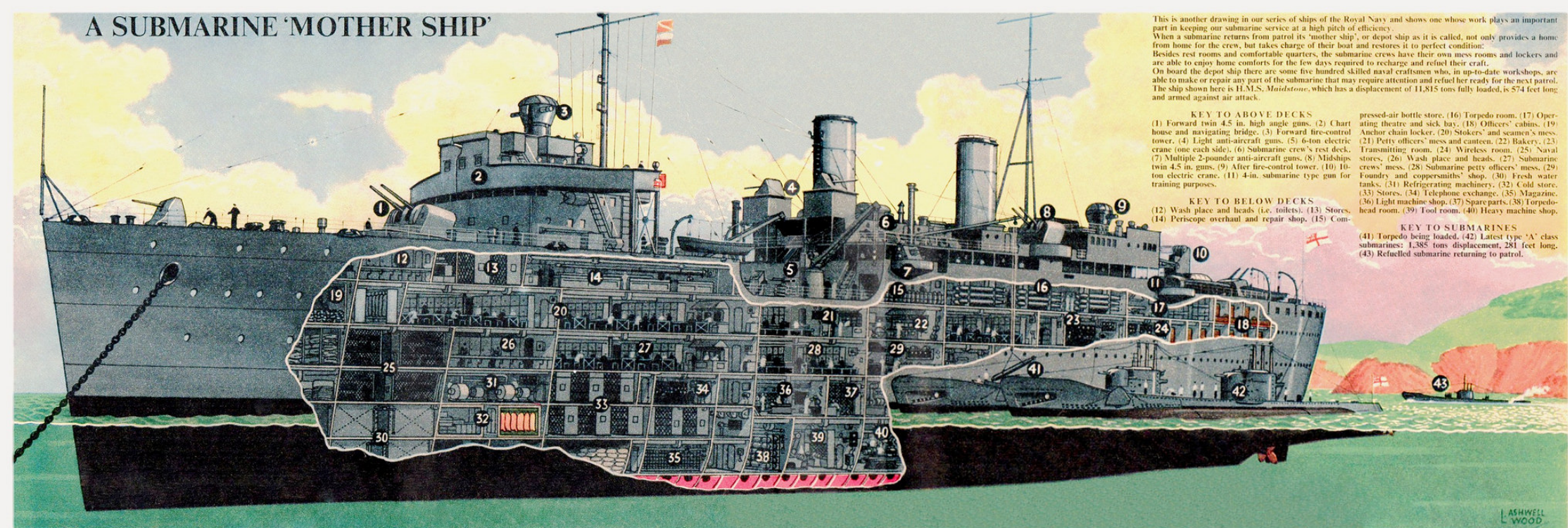
KEY TO BELOW DECKS

(12) Wash place and heads (i.e. toilets). (13) Stores. (14) Periscope overhaul and repair shop. (15) Com-

pressed-air bottle store. (16) Torpedo room. (17) Operating theatre and sick bay. (18) Officers' cabins. (19) Anchor chain locker. (20) Stokers' and seamen's mess. (21) Petty officers' mess and canteen. (22) Bakery. (23) Transmitting room. (24) Wireless room. (25) Naval stores. (26) Wash place and heads. (27) Submarine crews' mess. (28) Submarine petty officers' mess. (29) Foundry and coppersmiths' shop. (30) Fresh water tanks. (31) Refrigerating machinery. (32) Cold store. (33) Stores. (34) Telephone exchange. (35) Magazine. (36) Light machine shop. (37) Spare parts. (38) Torpedo-head room. (39) Tool room. (40) Heavy machine shop.

KEY TO SUBMARINES

(41) Torpedo being loaded. (42) Latest type 'A' class submarines: 1,385 tons displacement, 281 feet long. (43) Refuelled submarine returning to patrol.



A GAS TURBINE FAST-GUNBOAT

H.M.S. GREY GOOSE

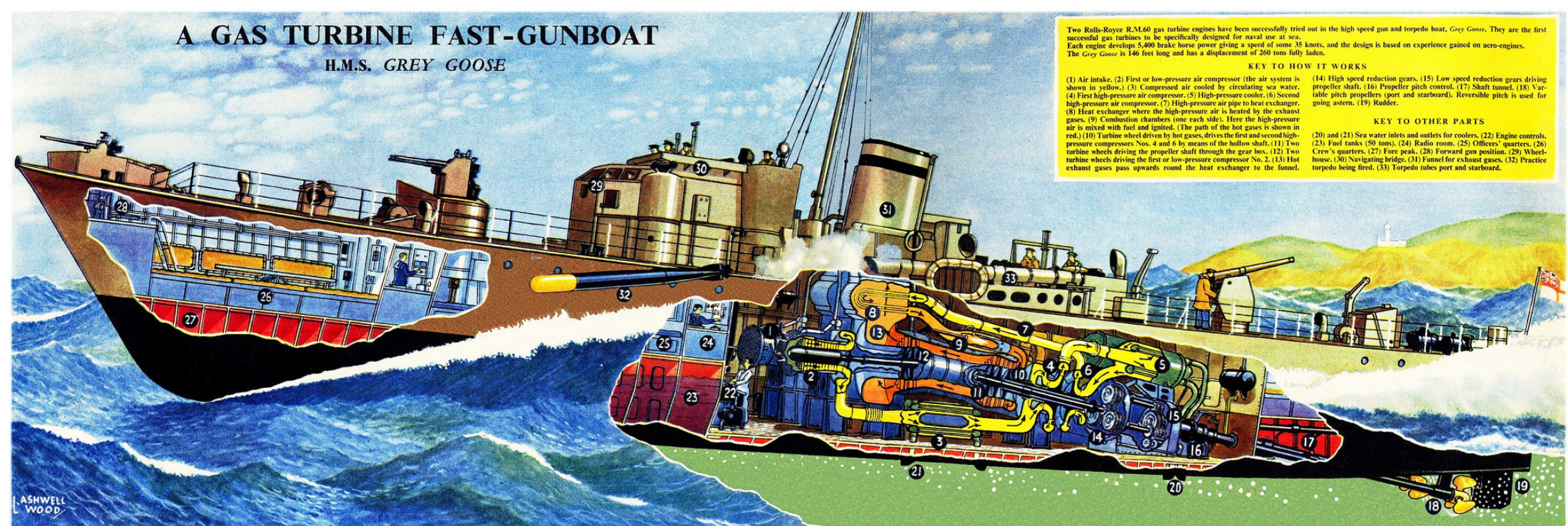
Two Rolls-Royce R.M.60 gas turbine engines have been successfully tried out in the high speed gun and torpedo boat, *Grey Goose*. They are the first successful gas turbines to be specifically designed for naval use at sea. Each engine develops 5,400 brake horse power giving a speed of some 35 knots, and the design is based on experience gained on aero-engines. The *Grey Goose* is 146 feet long and has a displacement of 260 tons fully laden.

KEY TO HOW IT WORKS

- (1) Air intake. (2) First or low-pressure air compressor (the air system is shown in yellow.) (3) Compressed air cooled by circulating sea water. (4) First high-pressure air compressor. (5) High-pressure cooler. (6) Second high-pressure air compressor. (7) High-pressure air pipe to heat exchanger. (8) Heat exchanger where the high-pressure air is heated by the exhaust gases. (9) Combustion chambers (one each side). Here the high-pressure air is mixed with fuel and ignited. (The path of the hot gases is shown in red.) (10) Turbine wheel driven by hot gases, drives the first and second high-pressure compressors Nos. 4 and 6 by means of the hollow shaft. (11) Two turbine wheels driving the propeller shaft through the gear box. (12) Two turbine wheels driving the propeller shaft through the gear box. (13) Hot exhaust gases pass upwards round the heat exchanger to the funnel. (14) High speed reduction gears. (15) Low speed reduction gears driving propeller shaft. (16) Propeller pitch control. (17) Shaft tunnel. (18) Variable pitch propellers (port and starboard). Reversible pitch is used for going astern. (19) Rudder.

KEY TO OTHER PARTS

- (20) and (21) Sea water inlets and outlets for coolers. (22) Engine controls. (23) Fuel tanks (50 tons). (24) Radio room. (25) Officers' quarters. (26) Crew's quarters. (27) Fore peak. (28) Forward gun position. (29) Wheelhouse. (30) Navigating bridge. (31) Funnel for exhaust gases. (32) Practice torpedo being fired. (33) Torpedo tubes port and starboard.



LONDON'S new landmark

Rising stark above London's skyline is a new and impressive landmark, the Post Office Tower. The new Tower will be the tallest building in Britain. Situated near Tottenham Court Road, the Tower is no 'head-in-the-clouds' venture, for it plays an important part in London's communication system.

Telephone conversations, besides being carried by wire, are nowadays transmitted by micro-wave radio beams, each beam being capable of carrying over a thousand individual telephone calls at once. These beams are rather like searchlight beams, and are transmitted from aerials which are situated high enough to give the beams an obstacle-free path. Hence the reason for the Post Office Tower – to carry aerials high enough to transmit and receive beams far above the roof-top level of the highest of London's buildings.

From the Tower will radiate telephone calls to quarters as far afield as Manchester, Norwich, Bristol and Southampton – but not direct, however, as the beams are limited to a range of some 30 miles and must be relayed to their destination in a series of hops by relay stations which receive and re-transmit the beams. Provision is also made for television programmes to be relayed.

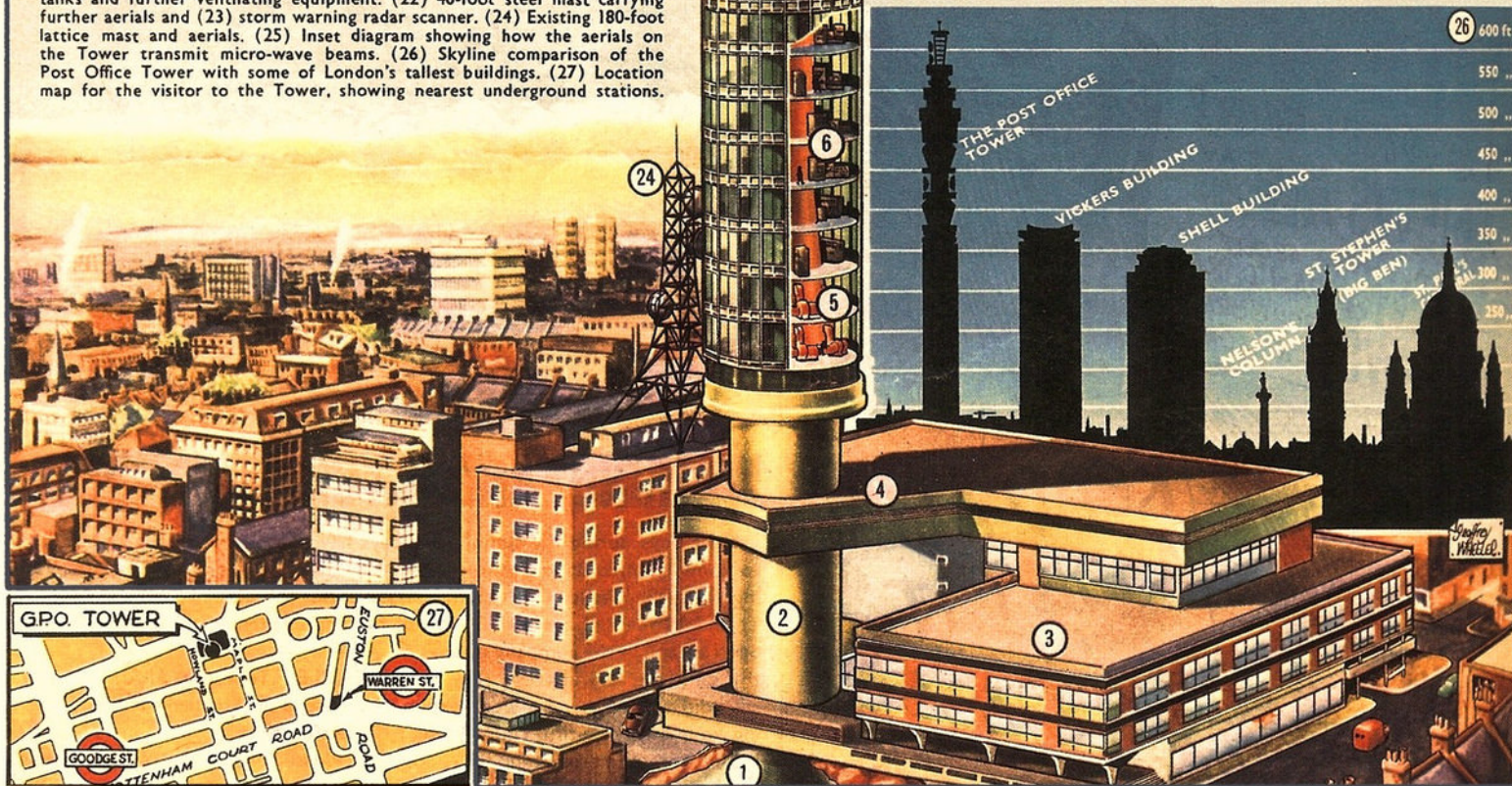
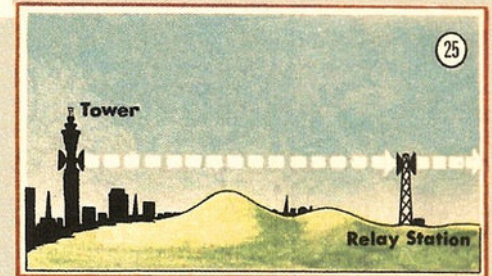
The Tower is 620 feet high, and weighs 13,000 tons. It is constructed of concrete reinforced with high tensile and mild steel and has no less than 50,000 square feet of glass on its outside covering. It will withstand high winds with the minimum of deflection – so as not to upset the alignment of the radio beams. Gusts of 90 m.p.h. are estimated to induce a deflection of 15 inches at the top of the Tower!

The Tower will be open to visitors, to provide a vast panoramic viewpoint overlooking the whole of London, and will also offer refreshments in a rotating restaurant near the top.

KEY TO NUMBERED PARTS

(1) Pre-stressed concrete foundations. (2) Reinforced concrete shaft. This extends the full height of the Tower and forms the backbone around which the Tower is built, and contains the lift shaft, ventilating ducts and cables for radio equipment, etc. (3) The new MUSEum Telephone Exchange. (4) Connecting bridge from Exchange building to Tower, which also serves to brace the Tower. (5) High velocity ventilating equipment rooms. (6) Transmitting apparatus rooms containing telephone and television equipment. These extend for 13 further floors. (7) Double glazing with automatic Venetian blinds sandwiched between glass. (8) Rails extending the full height of the glazed portion to accommodate special power-operated cradles for window cleaning. (9) Two high-speed lifts capable of travelling at 1,000 feet per minute – the fastest lifts in Britain. (10) Aerial galleries supporting horn aerials (11) and dish aerials (12) for micro-wave transmission. (13) Aerial inspection platforms. (14), (15) and (16) Open and closed public observation platforms. (17) The unique revolving restaurant with an all-round view of London, completing one revolution in approximately half-an-hour. (18) Cocktail bar. (19) Kitchen. (20) Lift pulley compartments. (21) Room containing high-speed lift motors, water tanks and further ventilating equipment. (22) 40-foot steel mast carrying further aerials and (23) storm warning radar scanner. (24) Existing 180-foot lattice mast and aerials. (25) Inset diagram showing how the aerials on the Tower transmit micro-wave beams. (26) Skyline comparison of the Post Office Tower with some of London's tallest buildings. (27) Location map for the visitor to the Tower, showing nearest underground stations.

This week we take a detailed look at the G.P.O. Tower which opens next year. No doubt it will still be in use in the next century – judging by the battle Dan Dare and Xel are having on our front cover!



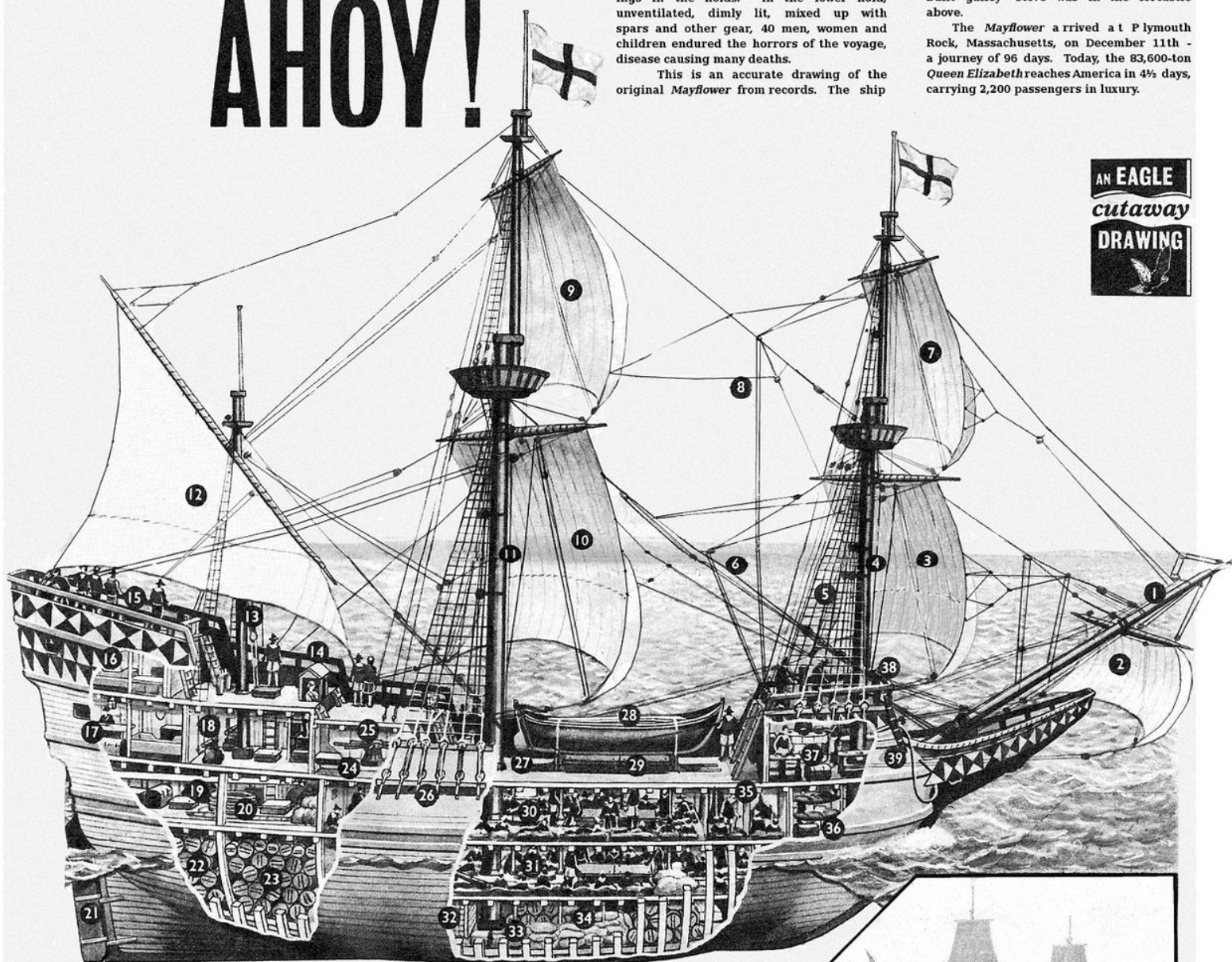
MAYFLOWER AHOY!

OUR cutaway drawing this week turns the clock back over 345 years to when the *Mayflower* sailed from Plymouth to America on September 6th, 1620, carrying the Pilgrim Fathers to the New World. The 102 pilgrims were comprised of 50 men, 20 women, and 32 children - with a crew of 20 men. The passengers pitched their beds and belongings in the holds. In the lower hold, unventilated, dimly lit, mixed up with spars and other gear, 40 men, women and children endured the horrors of the voyage, disease causing many deaths.

This is an accurate drawing of the original *Mayflower* from records. The ship

was rigged with the usual three masts of the period with six sails. She weighed about 180 tons, was some 90 feet long and 26 feet wide. In the bottom hold she carried barrels of bread, biscuits, fresh water, agricultural machinery, iron, lead, tools, etc. Forward in the bottom hold were stores of smoked beef, salt pork, onions, turnips and beer in barrels. The stone-built galley stove was in the forecabin above.

The *Mayflower* arrived at Plymouth Rock, Massachusetts, on December 11th - a journey of 96 days. Today, the 83,600-ton *Queen Elizabeth* reaches America in 4½ days, carrying 2,200 passengers in luxury.



PIONEER RATIONS

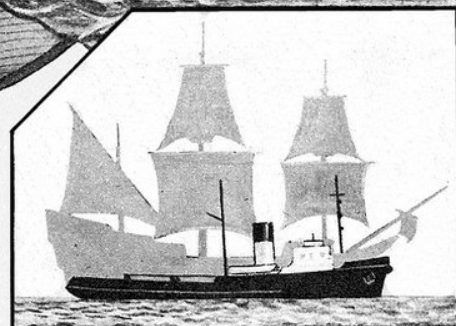
The day-by-day ration of food for the 122 passengers and crew of the *Mayflower* compared with that of the Christmas fare of H.M.S. *Eagle* . . . Bread 30 lb.; Biscuits 30 lb.; Smoked beef 15 lb.; Dried tongue or salt pork 15 lb.; Dried onions, turnips, etc. 30 lb.; Fresh water (15 gallons) 150 lb. A total of 270 lb. or about 2½ cwt. per day.

The total for the voyage of 96 days was just over 11 tons, compared with H.M.S. *Eagle's* 11 tons of food in one day (not including fresh water).

Many died of disease during the voyage of the *Mayflower*, especially of scurvy, caused by long confinement, lack of fresh vegetables and Vitamin C.

KEY TO NUMBERED PARTS

- (1) Bowsprit. (2) Sprit sail. (3) Fore water. (23) Barrels of biscuits and bread. (24) Four private cabins. (25) Capstan. (26) Shroud anchor rigging. (6) Mast braces. (7) Fore topsail. (8) Running rigging. (9) Main topsail. (10) Main sail. (11) Main mast. (12) Mizzen sail. (13) Mizzen mast. (14) Helmsman's steering position. (15) Poop deck. (16) Master's cabin. (17) Great cabin. (18) Saluting guns. (19) Steering tiller. (20) Tiller room. (21) Rudder. (22) Barrels of fresh
- (4) Foremast. (5) Shroud rigging. (6) Mast braces. (7) Fore topsail. (8) Running rigging. (9) Main topsail. (10) Main sail. (11) Main mast. (12) Mizzen sail. (13) Mizzen mast. (14) Helmsman's steering position. (15) Poop deck. (16) Master's cabin. (17) Great cabin. (18) Saluting guns. (19) Steering tiller. (20) Tiller room. (21) Rudder. (22) Barrels of fresh
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- (28) Longboat. (29) Main hatch. (30) Upper hold. (31) Lower hold. (32) Tools, etc. (33) Timber ribs of hull, covered with planking. (34) General stores. (35) Canvas divisions for privacy. (36) Crew's quarters. (37) Galley. (38) Forecabin. (39) Starboard



The *Mayflower* compared in size to a modern harbour tug.

H.M.S. WORCESTER

Moored off Greenhithe, Kent, hard by the track of London's shipping, is H.M.S. Worcester -- the Thames Nautical Training College -- which celebrates its centenary in 1962. It trains boys as officer-cadets for entry to the Royal and Merchant Navies, at the same time continuing their general education to G.C.E. level. They join at about 14 and, on successfully completing the course at 17-plus they have only to do three, instead of the usual four, years' sea-going cadetship.

The third of her name, the present Worcester -- 5,480 tons gross -- was built in 1905 as the *Exmouth* at Barrow. She was acquired in 1946, after serving as a depot ship for minesweepers during the war. Her hull, of iron and steel, is 346 ft. long, and has a breadth of 53 ft. She is equipped with class-rooms and laboratory, and the latest navigational aids found in modern liners -- including radar, Decca navigator, gyro-compass, Marconi direction-finder, and echo-sounder. H.M.S. Worcester's normal complement is thirty officers and masters, with 250 cadets.

KEY TO NUMBERED PARTS

- (1) Captain's quarters (Wardroom beneath).
- (2) Director of Studies' office (Senior Master on left).
- (3) Captain's office.
- (4) Physics laboratory.
- (5) Gunroom.
- (6) 3-ton derrick.
- (7) Binnacle, D/F loop and radar-scanner (over chart-house).
- (8) Overhead gravity davits (another type aft).
- (9) Carpenter's shop.
- (10) Cadets' washplace and lavatories (water tanks above).
- (11) Cabins (Sick Bay further aft).
- (12) Senior class-room.
- (13) Senior Cadets' bunk-space.
- (14) Main deck (beneath are Lower, Orlop and Tier decks).
- (15) Cadets' Messroom.
- (16) Junior Library and Chapel, (port side).
- (17) Tuck-shop.
- (18) Class-rooms.
- (19) Junior Cadets' bunk-space.
- (20) Recreation space.
- (21) Thermotank unit.
- (22) Preparing room (above; Engineers' Mess (below)).
- (23) Engineers' workshop.
- (24) Boilers.
- (25) Galley.
- (26) Seamanship instruction room.
- (27) Canvas store.
- (28) Boatswain's store.
- (29) Oil fuel tanks.
- (30) Auxiliary machinery.

NEW FOCUS on the PLANETS

HIGH up—6,200 feet—on top of Mount Kobau, British Columbia, Canada, will be built the new *Queen Elizabeth II Astronomical Observatory*.

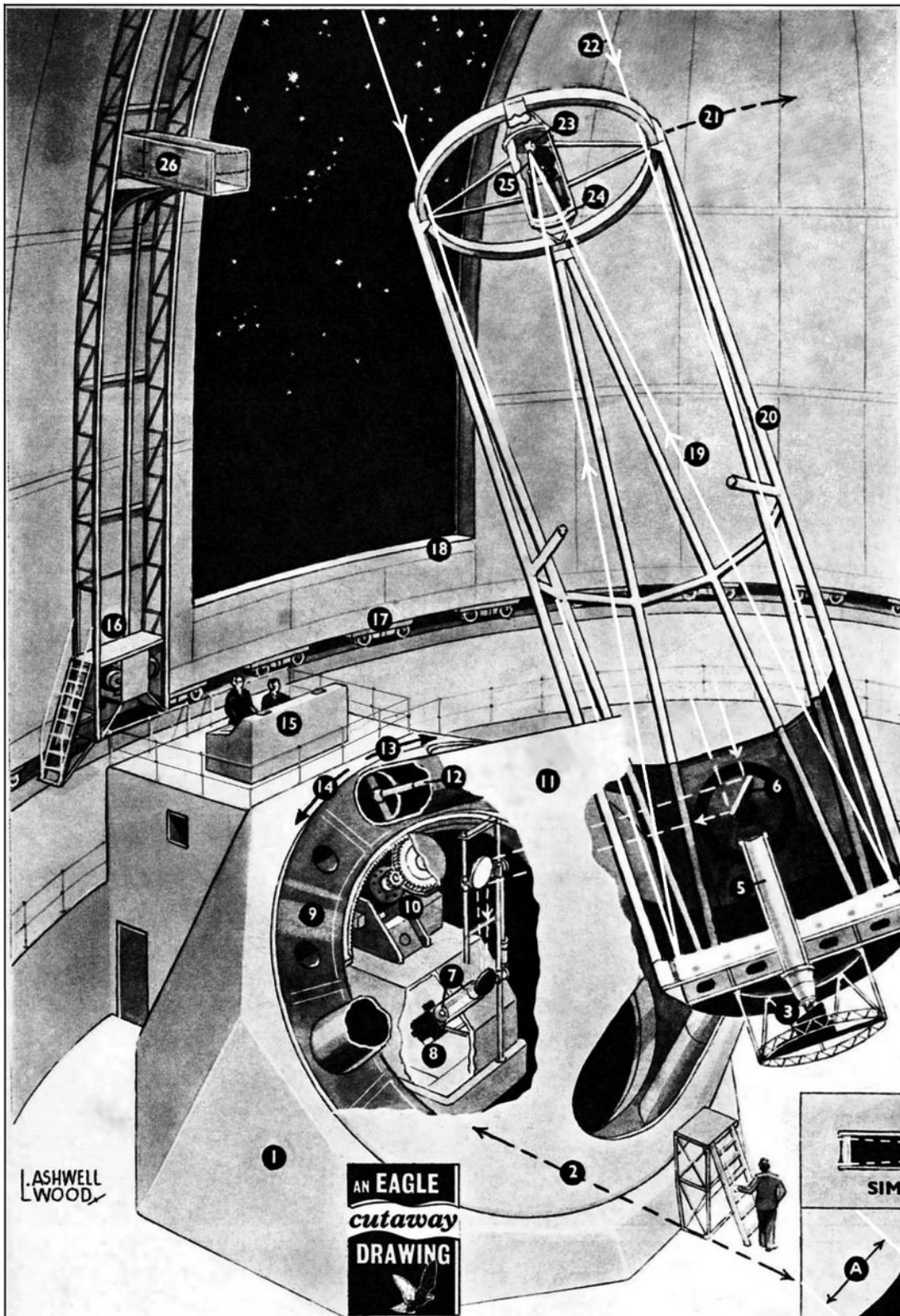
It will house the biggest optical telescope in the Commonwealth and the second biggest in the world (after America's Mount Palomar telescope which has a 200-inch reflector mirror).

The Canadian telescope will be of the reflecting type and have a reflecting mirror of 150 inches diameter, giving a prime focus of about 43 feet. The concrete mounting and all equipment will be built inside a rotating dome on the mountain top.

Spectrographic instruments will analyse the colour of starlight and give an indication of the elements which make up distant sources of light.

The most interesting task of the telescope will be the physical study of the moon and the planets of our own solar system, together with observations of atmospheres and the climate of Venus, Mars and Jupiter, which are needed in planning future exploration.

The cost of the observatory is estimated at £3,500,000 and will take about six years to complete.



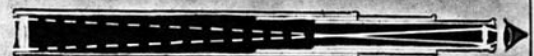
KEY TO NUMBERED PARTS

(1) Concrete support. (2) North-south polar axis. (3) Alternative Cassegrain Focus. This is reflected from a removable convex mirror in the observation chamber. (4) 150-inch-diameter reflector mirror. (5) Tube for Cassegrain Focus. (6) Removable mirror for Coudé Focus. (7) Point of Coudé Focus for spectroscopy. Here, a spectrum is formed, extending from red to violet—thus the white light from a star can be analysed. (8) Spectrographic camera. (9) Mounting ring for telescope support pivots. (10) Electric motor and gears for east-west movement of telescope-deflection. (11) Support pivot. (12) Drive to pivot for north-south movement of telescope—declination. (13) East movement. (14) West movement. (15) Power control desk. Operators are in telephone contact with observer. (16) Gantry for observer's entry platform. (17) Roller runners of rotating dome. (18) Ob-

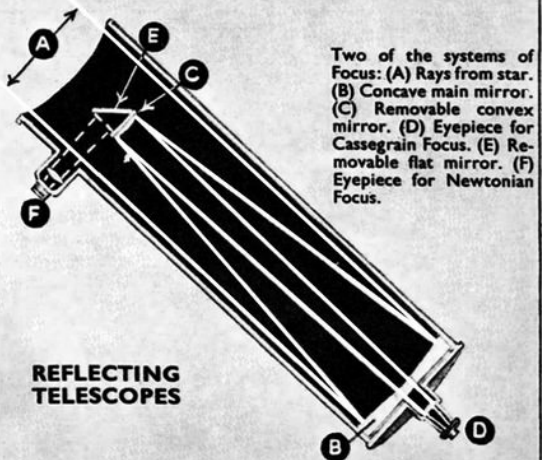
servation opening in dome. Can be closed by shutters. (19) Reflected rays from mirror to Prime Focus in observation chamber. (20) Tubular steel telescope structure. (21) North-south movement—declination. (22) Light rays from distant stars or planets. (23) Observer. (24) Removable mirrors for Cassegrain and Coudé Focus. (25) Prime Focus. (26) Platform for entry into observation chamber.

The telescope has three different systems of focus on the stars. The one seen in operation by the observer is the Prime (or main) focus. The second, or alternative focus, is called Coudé—used for spectrographic work. The third, called Cassegrain Focus, named after a French scientist, is used for photographic purposes. There is a fourth type of focus which is used on smaller telescopes—the Newtonian, after Sir Isaac Newton.

Below: There are two main types of telescope, known as Refracting and Reflecting. The simple refracting type uses an objective convex lens in front and a much smaller adjustable one in the eyepiece. The image is upside-down. The reflecting type uses a large concave mirror which reflects the rays back to a small mirror, which in turn reflects them back through a hole in the mirror to the eyepiece—Cassegrain Focus.



SIMPLE REFRACTING TELESCOPES



REFLECTING TELESCOPES

Two of the systems of Focus: (A) Rays from star. (B) Concave main mirror. (C) Removable convex mirror. (D) Eyepiece for Cassegrain Focus. (E) Removable flat mirror. (F) Eyepiece for Newtonian Focus.

There is always work for dredgers. Shifting sands and mudbanks constantly threaten the safety of navigation of ships in river estuaries and the approaches to many ports and harbours. Channels have to be cleared at regular intervals and the spoil—mud or sand—dumped out at sea, where it is out of harm's way.

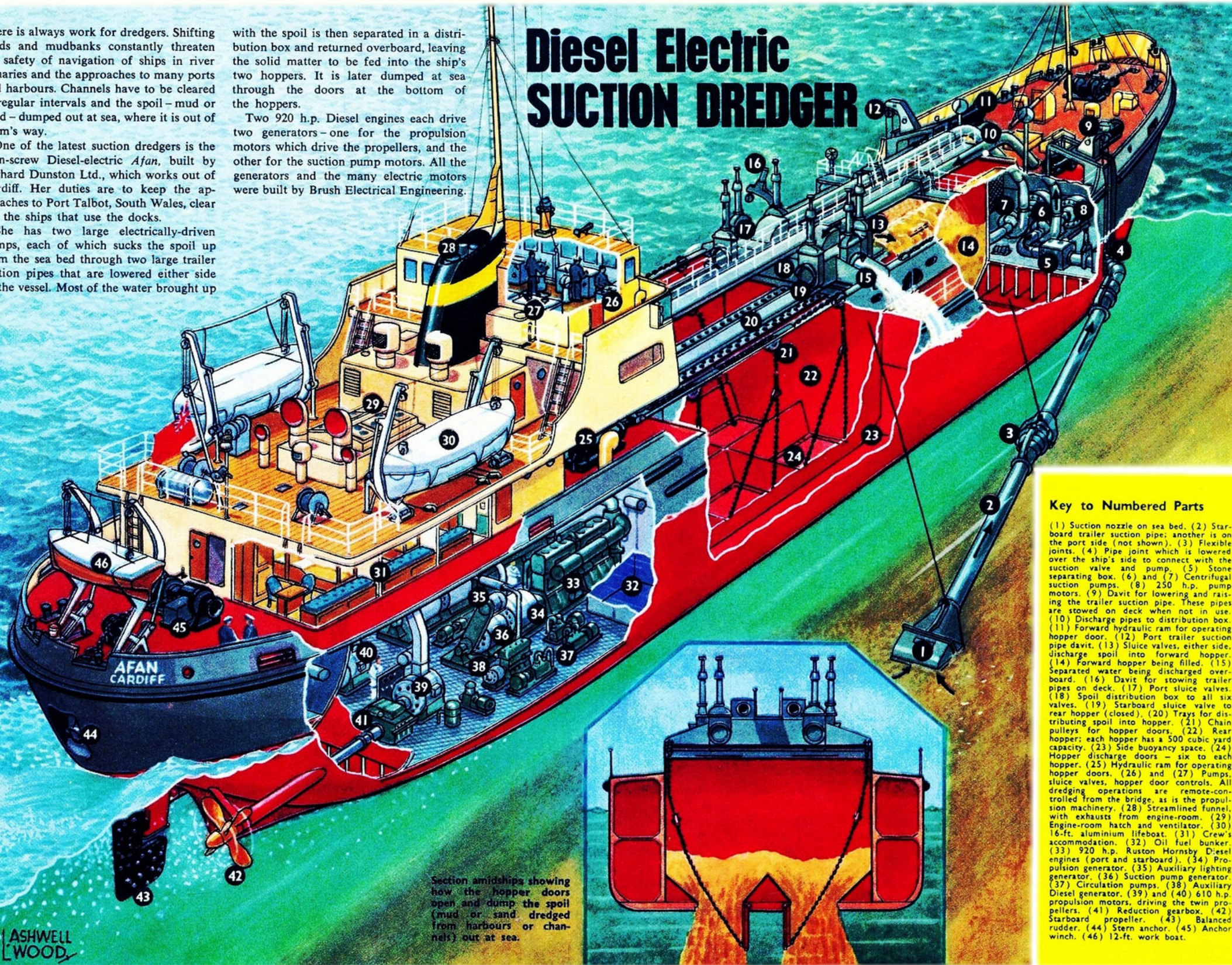
One of the latest suction dredgers is the twin-screw Diesel-electric *Afan*, built by Richard Dunston Ltd., which works out of Cardiff. Her duties are to keep the approaches to Port Talbot, South Wales, clear for the ships that use the docks.

She has two large electrically-driven pumps, each of which sucks the spoil up from the sea bed through two large trailer suction pipes that are lowered either side of the vessel. Most of the water brought up

with the spoil is then separated in a distribution box and returned overboard, leaving the solid matter to be fed into the ship's two hoppers. It is later dumped at sea through the doors at the bottom of the hoppers.

Two 920 h.p. Diesel engines each drive two generators—one for the propulsion motors which drive the propellers, and the other for the suction pump motors. All the generators and the many electric motors were built by Brush Electrical Engineering.

Diesel Electric SUCTION DREDGER

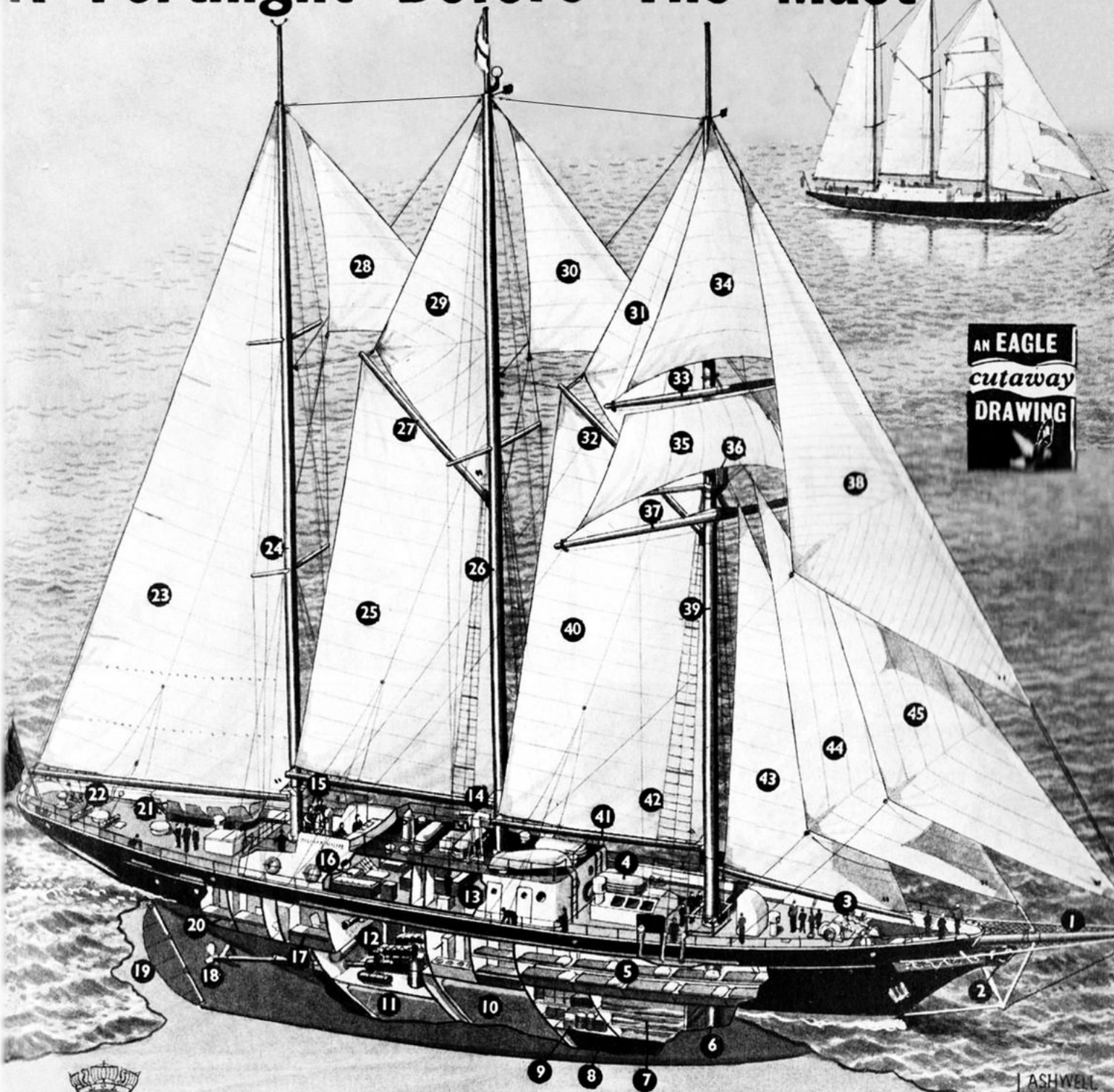


Key to Numbered Parts

(1) Suction nozzle on sea bed. (2) Starboard trailer suction pipe; another is on the port side (not shown). (3) Flexible joints. (4) Pipe joint which is lowered over the ship's side to connect with the suction valve and pump. (5) Stone separating box. (6) and (7) Centrifugal suction pumps. (8) 250 h.p. pump motors. (9) Davit for lowering and raising the trailer suction pipe. These pipes are stowed on deck when not in use. (10) Discharge pipes to distribution box. (11) Forward hydraulic ram for operating hopper door. (12) Port trailer suction pipe davit. (13) Sluice valves, either side, discharge spoil into forward hopper. (14) Forward hopper being filled. (15) Separated water being discharged overboard. (16) Davit for stowing trailer pipes on deck. (17) Port sluice valves. (18) Spoil distribution box to all six valves. (19) Starboard sluice valve to rear hopper (closed). (20) Trays for distributing spoil into hopper. (21) Chain pulleys for hopper doors. (22) Rear hopper; each hopper has a 500 cubic yard capacity. (23) Side buoyancy space. (24) Hopper discharge doors—six to each hopper. (25) Hydraulic ram for operating hopper doors. (26) and (27) Pumps, sluice valves, hopper door controls. All dredging operations are remote-controlled from the bridge, as is the propulsion machinery. (28) Streamlined funnel, with exhausts from engine-room. (29) Engine-room hatch and ventilator. (30) 16-ft. aluminium lifeboat. (31) Crew's accommodation. (32) Oil fuel bunker. (33) 920 h.p. Ruston Hornsby Diesel engines (port and starboard). (34) Propulsion generator. (35) Auxiliary lighting generator. (36) Suction pump generator. (37) Circulation pumps. (38) Auxiliary Diesel generator. (39) and (40) 610 h.p. propulsion motors, driving the twin propellers. (41) Reduction gearbox. (42) Starboard propeller. (43) Balanced rudder. (44) Stern anchor. (45) Anchor winch. (46) 12-ft. work boat.

Section amidships showing how the hopper doors open and dump the spoil (mud or sand dredged from harbours or channels) out at sea.

A Fortnight Before The Mast



Another adventure schooner, the Malcolm Miller, has recently joined her companion, 'Sir Winston Churchill' (shown top right). Both these topsail schooners belong to the Sail Training Association and their job is to take young men to sea, in batches of 40 at a time, for a fortnight's cruise. As soon as the boys board the ship they begin instruction in the basics of seamanship. They learn how to hoist a sail, trim them to the wind, steer a true course, and react to discipline and danger.

For many, it is the first time they have trodden a deck, but one reward will be plenty of good food. The S.T.A. is an entirely charitable body, and its patron is H.R.H The Prince Philip, Duke of Edinburgh, K.G. The 'Malcolm Miller', 300 tons, is 149ft. 10ins. long and has a beam of 25ft. Under full sail she can log nearly 14 knots but can plug along at a steady 8 or 9 knots. She cost over £130,000 and was designed by Camper and Nicholson Ltd., of Southampton, and built by John Lewis & Sons Ltd., of Aberdeen.

KEY TO NUMBERED PARTS OF THE HULL

(1) Bowsprit. (2) Figurehead. (3) Electric anchor windlass. (4) Life rafts. (5) Trainees' accommodation—mess room and 34 cot beds. (6) Foremast step. (7) Sail locker. (8) Lead ballast. (9) Food store. (10) Fresh-water tank—32½ tons capacity. (11) Oil fuel tanks. (12) Twin Perkins 120 h.p. Diesel engine. (13) Galley. (14) Radar scanner. (15) Steering helm and compass. (16) Saloon and chart room. (17) Captain's cabin. (18) Starboard propeller—power is only used for getting in or out of harbour. (19) Rudder. (20) Officers' cabins. (21) 16ft. motor boat.

KEY TO SAILS AND MASTS

Running rigging—a halliard is a rope which hoists a sail. A sheet is a rope which controls a sail. (22) Mizzen sheet runner. (23) Mizzen. (24) Mizzen mast (all three masts are aluminium metal). (25) Mainsail. (26) Main mast. (27) Gaff. (28) Mizzen topmast staysail. (29) Main topsail. (30) Main topsail staysail. (31) Fore topsail. (32) Gaff. (33) Upper yard. (34) Raffle (square sail). (35) Square topsail. (36) Crow's nest (look-out). (37) Lower yard (a large squaresail can also be set on this yard). (38) Jib topsail. (39) Foremast. (40) Foresail. (41) Booms. (42) Shrouds. (43) Staysail. (44) Inner jib. (45) Outer jib.

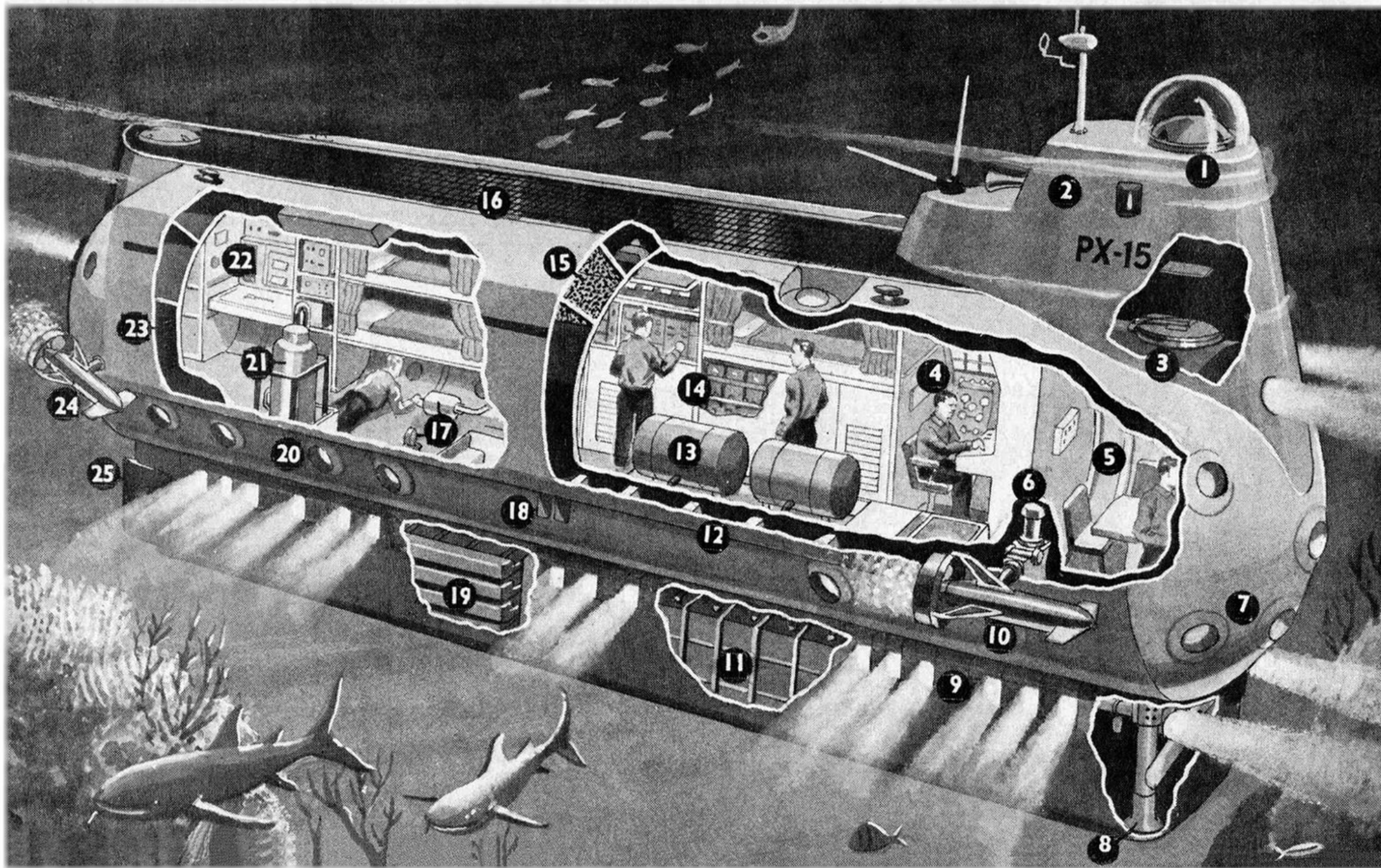
What Makes The Gulf Stream Flow?

This cutaway was part of a series captioned "The Futurescope" and was not actually an "Eagle Cutaway Drawing". However, it is included as the issue had no other cutaway and this drawing is too good to ignore. Some other "Futurescope" articles had cutaways, but rarely of similar detail.

The miniature submarine PX-15 under construction

KEY TO THE PX-15

- (1) Hatch and surface lookout. (2) Conning tower — radio and surface radar above. (3) Hatch and pressure hull. (4) Operational control centre. (5) Mess and wardroom. (6) Motor swivel gearbox. (7) Viewing ports. (8) Support legs when resting on sea-bed. (9) Side lights. (10) Forward starboard propulsion motor propeller — all four 25 m.p.h. motors swivel for vertical or horizontal propulsion. (11) Batteries for all electrical power. (12) Ballast tank and pressure hull. (13) Hot water tanks. (14) Battery inverters. (15) Iron shot—released in an emergency to bring craft to surface. (16) Walkway. (17) Biological sampler and cine-camera. (18) Side-looking sonar. (19) Battery oil containers. (20) Viewing ports. (21) Oxygen tank. (22) Scientific control centre. (23) Ballast tank. (24) Rear starboard propulsion motor. (25) Rudder for steering.



THE SNOWDON MOUNTAIN RAILWAY

The Snowdon Mountain Railway was opened to public traffic on April 6th, 1896, and it remains to-day unique, being the only one of its type in the United Kingdom.

The lower terminus is situated at picturesque Llanberis, and from there the railway climbs continually for just under 4½ miles to the summit – topping an altitude of 3,493 feet above sea-level.

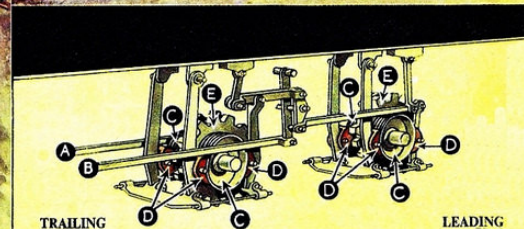
The railway is built on the Abt system, named after the eminent Swiss engineer, Dr Roman Abt, who first evolved it.

The locomotive is not coupled to the coach, and it therefore pushes from behind on the ascent of the mountain.

Altogether there are now seven locomotives operating on the railway. No. 1, which bore the name of "LADAS", was destroyed early in its career.

KEY TO NUMBERS.

(1) Two Rackrails laid side by side with teeth 'staggered'. (2) Guard Rails laid each side of Rack. Safety-grippers suspended beneath loco embrace these, thus preventing any possibility of the engine wheels mounting the trackrails. (3) Coal bunker. Capacity 11.8 cwt. (4) Side water tanks. Total capacity 525 gallons. (5) Cab gate. (6) Whistle. (7) Driving cab. (8) Firebox stays. (9) Firebox. (10) Throttle valve in dome. (11) Fire tubes for heating water. (12) Water level. This must be kept high to ensure that the firebox crown is always well covered. (13) Boiler with an inclination of 1 in 11. (14) Chimney bonnet. This is put on at the Summit Station and damps the natural draught of the fire on the descending journey. (15) Superheater. (16) Smokebox. (17) Crosshead. (18) Slide bar. (19) Rocker arm. (20) Piston rod. (21) Valve rocker. (22) Piston. (23) Outside frame. (24) Pinion coupling rod. The road wheels are not coupled. (25) Road wheels. These play no part in the drive of the locomotive, but ride 'loose' on the pinion shafts which serve as carrying axles. (26) Trailer truck wheels. (27) Trailer truck swivel. (28) Inside frame. (29) Wheel housing which allows road wheels to revolve freely on pinion shaft. (30) Two rack pinions fixed to pinion shaft. There are also two more on the leading shaft, making four in all. These drive the locomotive by climbing tooth by tooth along the rackrail. The two lots of teeth are set permanently out of step in such a manner that one set is always in maximum engagement with the teeth of the rackrail during each successive disengagement of the other. (31) Tail rod cover. (32) Piston valves. (33) Cylinder. (34) Steel sleepers. (35) Track Gauge 2 ft. 7½ inches.

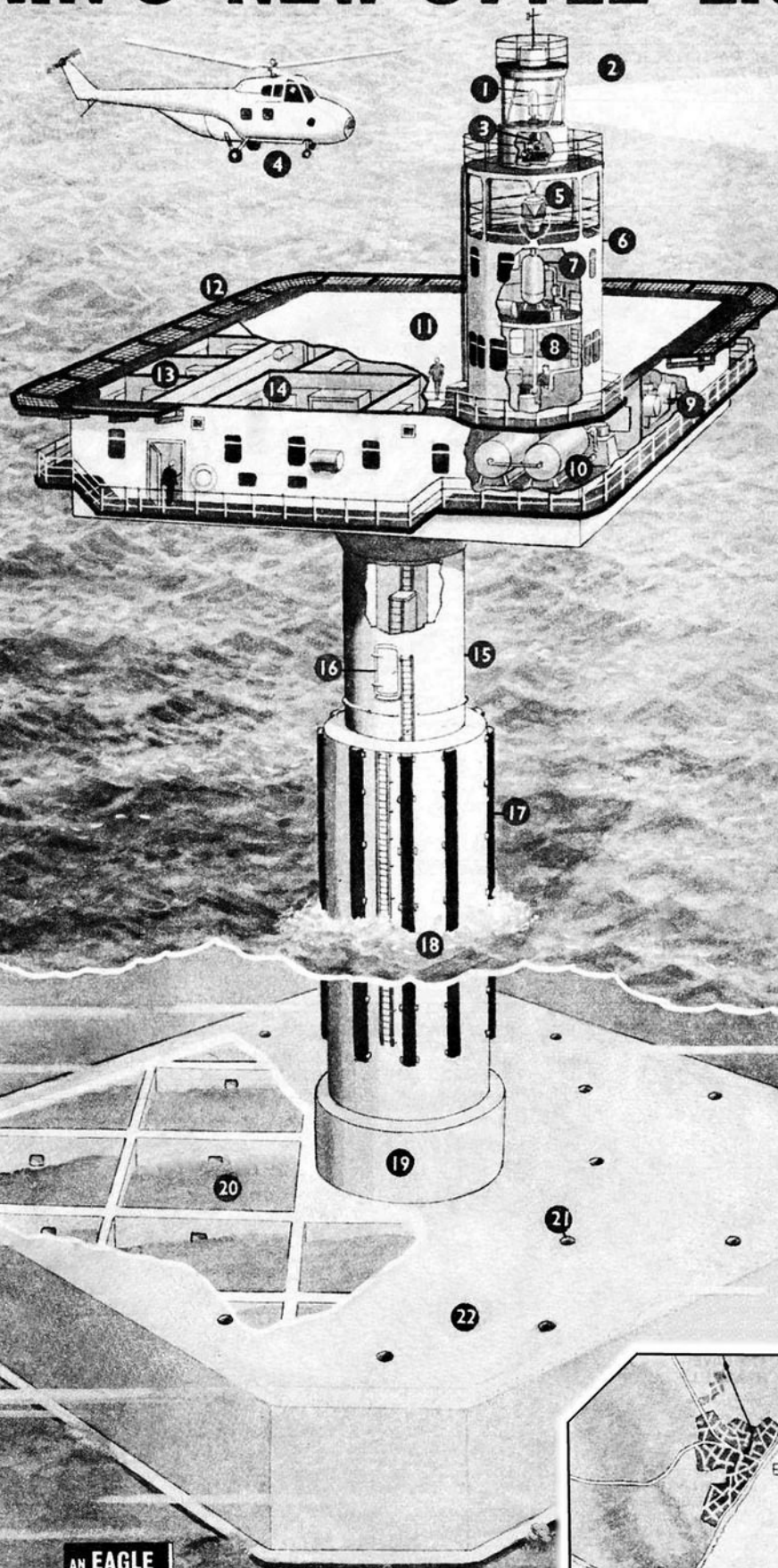


(Top) Train crossing Afon Hwch Viaduct with one of the latest type coaches soon after leaving the lower terminus at Llanberis. The viaduct has a gradient of 1 in 8½.

(Lower) Diagram of the Snowdon friction brake gear. The brake gear is omitted from the large illustration for the sake of clarity.

An ingenious system of levers and linkages automatically equalizes the braking force of eight shoes, two to each driving pinion. It can be applied by hand or by steam. (A) Fireman's pull-rod. (B) Driver's pull-rod. (C) Corrugated drums fixed on shaft each side of pinions. (D) Grooved blocks which contract about drums. (E) Pinions. Duplicate set of levers not shown.

BRITAIN'S NEW-STYLE LIGHTHOUSE



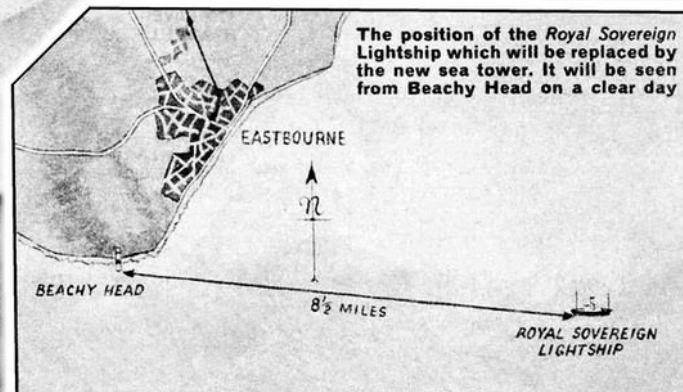
Trinity House, which maintains the lighthouses and lightships around our coasts, are to build a new £500,000 Light Tower rising 151 ft. above sea level. It will replace the *Royal Sovereign* lightship in the English Channel off Beachy Head.

The new-style lighthouse, constructed of reinforced concrete, will comprise a base sub-divided into cells. A circular central column will have enclosed cabins on top to house the accommodation and machinery, and the roof will form a helicopter deck. A steel light tower will rise above. The base and column will be towed to the site and the base filled with sand after it has been placed in position on the sea bed. The cabins will then be raised to the top of the column, at a height of 93 ft. above sea level. The sea tower, weighing 5,625 tons, will be designed to withstand any storms likely to be met, the highest wave being estimated at 53 ft.

There will be a crew of three and the flashing light will be $2\frac{1}{2}$ million candlepower. The light will rotate on a turntable described as 'the slowest electric motor in the world'. It will use less power than a gramophone motor to turn the 800-lb. lens. There will be a powerful foghorn, and radio communication with the shore will be provided together with a radio beacon.

Key to numbered parts

(1) Rotating $2\frac{1}{2}$ million candle-power light. (2) Light flashes white every 20 seconds - visibility 20 miles. (3) Turntable motor. (4) 'Whirlwind' helicopter - this can bring stores and relief crew in rough weather. (5) Diaphone fog horn. (6) Steel light tower. (7) Diaphone service room and sound apparatus. (8) Radio and lighthouse service room. (9) Diesel-electric generator sets. These supply power for the light and cabin services. (10) Compressed-air storage tanks for foghorn. (11) Helicopter deck. (12) Helicopter safety nets. (13) Separate bedrooms for crew of three. (14) Television lounge; there are also a hobbies room, kitchen, launderette, refrigerators and bathroom. (15) Concrete tower. (16) Entrance door used from or to relief boats. (17) Boat fenders. (18) Normal sea level between tides. (19) Tower base. (20) Base cells filled with sand. (21) Sea water vents. (22) Cellular concrete base placed on sea bed.

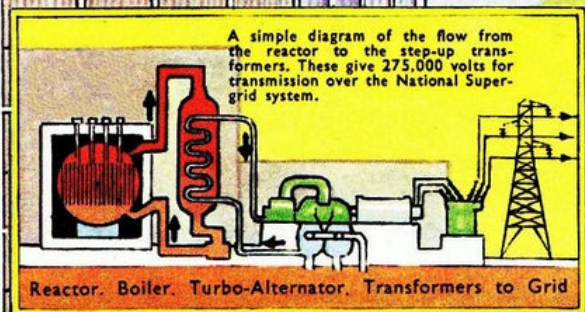
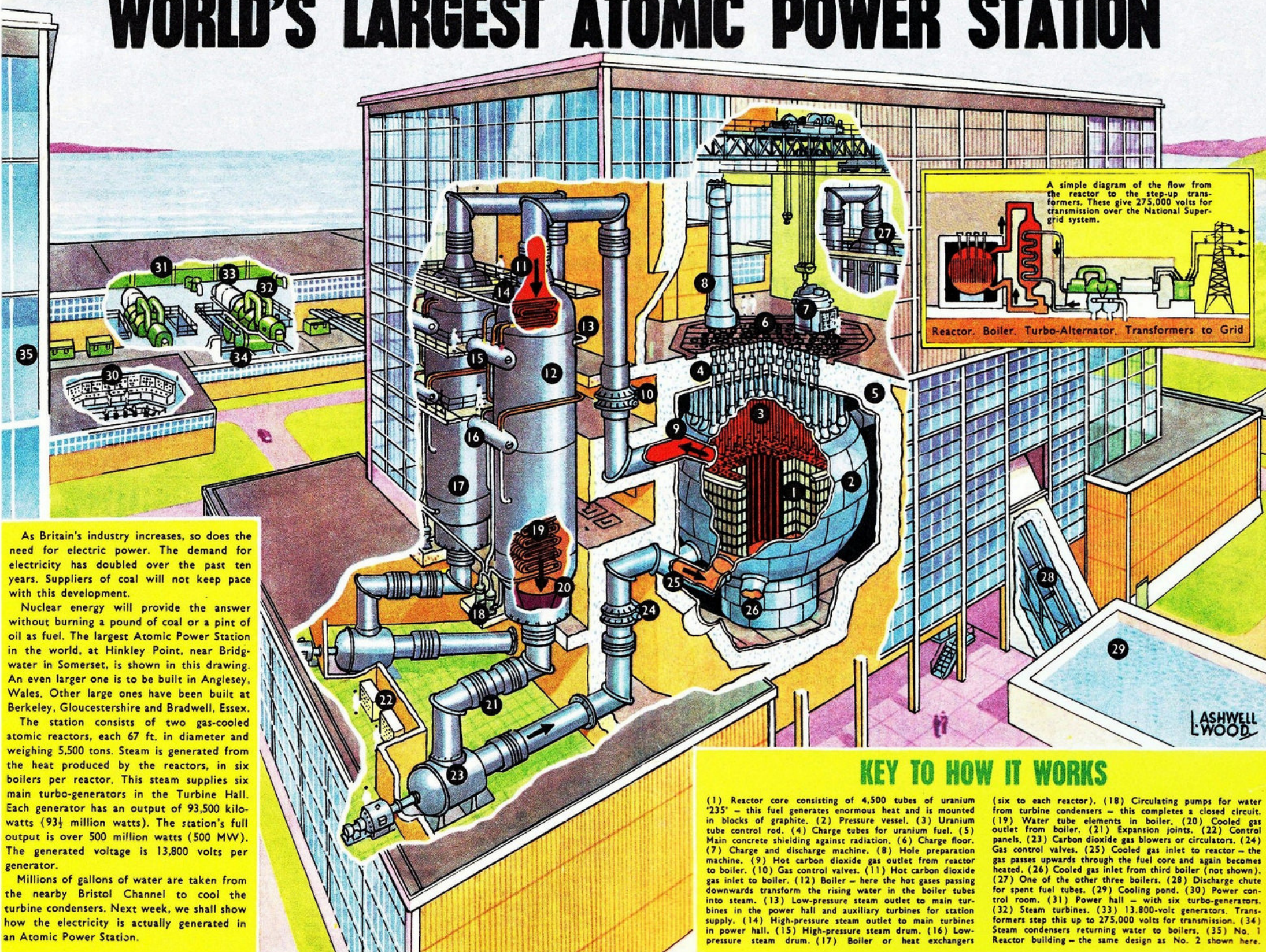


The position of the *Royal Sovereign* Lightship which will be replaced by the new sea tower. It will be seen from Beachy Head on a clear day

ASHWELL
WOOD

AN EAGLE
cutaway
DRAWING

WORLD'S LARGEST ATOMIC POWER STATION



As Britain's industry increases, so does the need for electric power. The demand for electricity has doubled over the past ten years. Suppliers of coal will not keep pace with this development.

Nuclear energy will provide the answer without burning a pound of coal or a pint of oil as fuel. The largest Atomic Power Station in the world, at Hinkley Point, near Bridgwater in Somerset, is shown in this drawing. An even larger one is to be built in Anglesey, Wales. Other large ones have been built at Berkeley, Gloucestershire and Bradwell, Essex.

The station consists of two gas-cooled atomic reactors, each 67 ft. in diameter and weighing 5,500 tons. Steam is generated from the heat produced by the reactors, in six boilers per reactor. This steam supplies six main turbo-generators in the Turbine Hall. Each generator has an output of 93,500 kilowatts (93½ million watts). The station's full output is over 500 million watts (500 MW). The generated voltage is 13,800 volts per generator.

Millions of gallons of water are taken from the nearby Bristol Channel to cool the turbine condensers. Next week, we shall show how the electricity is actually generated in an Atomic Power Station.

KEY TO HOW IT WORKS

- (1) Reactor core consisting of 4,500 tubes of uranium '235' - this fuel generates enormous heat and is mounted in blocks of graphite. (2) Pressure vessel. (3) Uranium tube control rod. (4) Charge tubes for uranium fuel. (5) Main concrete shielding against radiation. (6) Charge floor. (7) Charge and discharge machine. (8) Hole preparation machine. (9) Hot carbon dioxide gas outlet from reactor to boiler. (10) Gas control valves. (11) Hot carbon dioxide gas inlet to boiler. (12) Boiler - here the hot gases passing downwards transform the rising water in the boiler tubes into steam. (13) Low-pressure steam outlet to main turbines in the power hall and auxiliary turbines for station supply. (14) High-pressure steam outlet to main turbines in power hall. (15) High-pressure steam drum. (16) Low-pressure steam drum. (17) Boiler or heat exchangers (six to each reactor). (18) Circulating pumps for water from turbine condensers - this completes a closed circuit. (19) Water tube elements in boiler. (20) Cooled gas outlet from boiler. (21) Expansion joints. (22) Control panels. (23) Carbon dioxide gas blowers or circulators. (24) Gas control valves. (25) Cooled gas inlet to reactor - the gas passes upwards through the fuel core and again becomes heated. (26) Cooled gas inlet from third boiler (not shown). (27) One of the other three boilers. (28) Discharge chute for spent fuel tubes. (29) Cooling pond. (30) Power control room. (31) Power hall - with six turbo-generators. (32) Steam turbines. (33) 13,800-volt generators. Transformers step this up to 275,000 volts for transmission. (34) Steam condensers returning water to boilers. (35) No. 1 Reactor building - the same design as No. 2 shown here.

ASHWELL L'WOOD

LOCOMOTIVE COALING PLANTS, AND HOW THEY WORK

WAGON HOIST TYPE (Left)

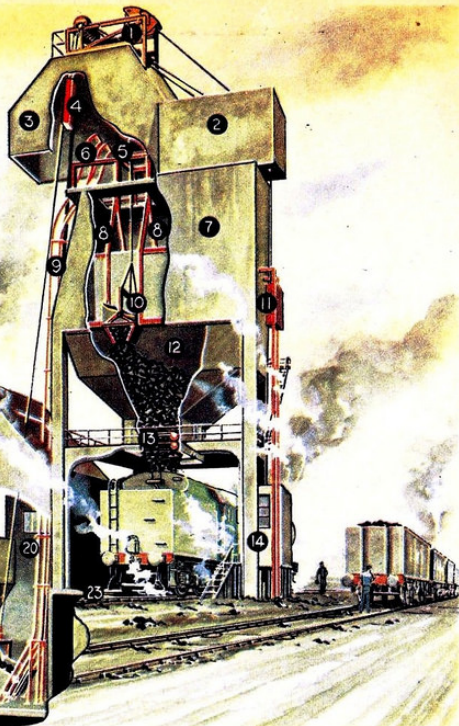
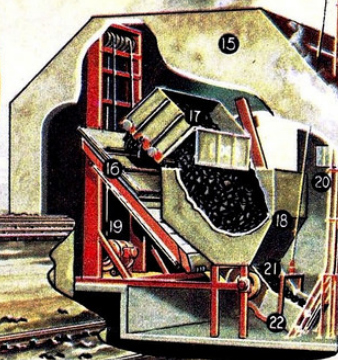
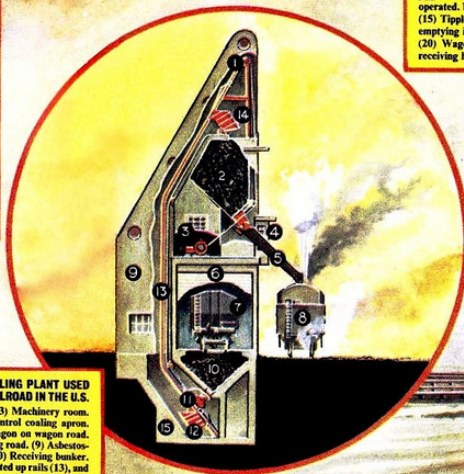
This is the most modern type of coaling plant in use on British Railways. (1) Machinery house. (2) Cable-winding drums worked by - (3) 30 h.p. electric motor fitted with magnetic brake. (4) Wagon cradle counterweights. (5) Hood. (6) Counterweight guides. (7) Galleries. (8) Hand winch for operating two-way flap. (9) Reinforced concrete structure. (10) Receiving bunker. (11) Two-way flap which can be operated to close the opening of one or the other of the two storage bunkers, thus enabling coal to be shot into the one left open. (12) Bulkhead dividing storage bunkers. (13) Anti-breakage trunks. (14) and (15) Storage bunkers, each of 75 tons capacity. These bunkers allow for two grades, or qualities, of coal to be stored ready for feeding to locomotives as required. (16) Hoisting cables. (17) 5 h.p. electric motors for operating jig feeders. (18) Coal being gravity-fed to jig feeder. (19) Water pipe connected to sprays for damping down coal-dust during operations. (20) Three-way flap which can be controlled to regulate the feeding of coal to the tender. (21) Operating shaft and linkages for three-way flap. (22) Meter automatically recording amount of coal supplied. (23) Tender of locomotive on coaling road receiving supply of coal. (24) Operators' cabins. (25) Control cabin. (26) Exterior gallery. (27) Cradle runways. (28) Coal wagon in position on cradle. (29) Wagon road. (30) Wagon cradle. The wagon is hoisted bodily upon this into the hood (5), where it automatically tilts, tipping its contents into receiving bunker (10). (31) Concrete-lined pit.

SKIP HOIST TYPE (Right)

(1) Head sheave (2) Skip control room. (3) Hood. (4) Skip hoist counterweight. (5) Exchange platform for skips. (6) The coal is tipped here into the anti-breakage skip for transference to storage bunkers. (7) Reinforced concrete structure. (8) Switches for the two storage bunkers. (9) Skip hoist runways. (10) Anti-breakage skip. (11) Anti-breakage skip counterweight. (12) Storage bunker; capacity 160 tons. A second bunker of 90 tons capacity is situated beyond this. The former for best coal, and the latter for common coal. (13) Electric jigger feeders. (14) Control cabin from which the jigger feeders are operated. It also contains a meter to record the amount of coal supplied. (15) Tippler house. (16) Tippler. (17) Coal wagon, hoisted on tippler, emptying its load into receiving hopper (18). (19) Electric tippler gear. (20) Wagon control cabin. (21) Chute. (22) Skip being filled from receiving hopper. (23) Locomotive on coaling road.

ULTRA-MODERN DESIGN OF COALING PLANT USED ON THE CHESAPEAKE & OHIO RAILROAD IN THE U.S.

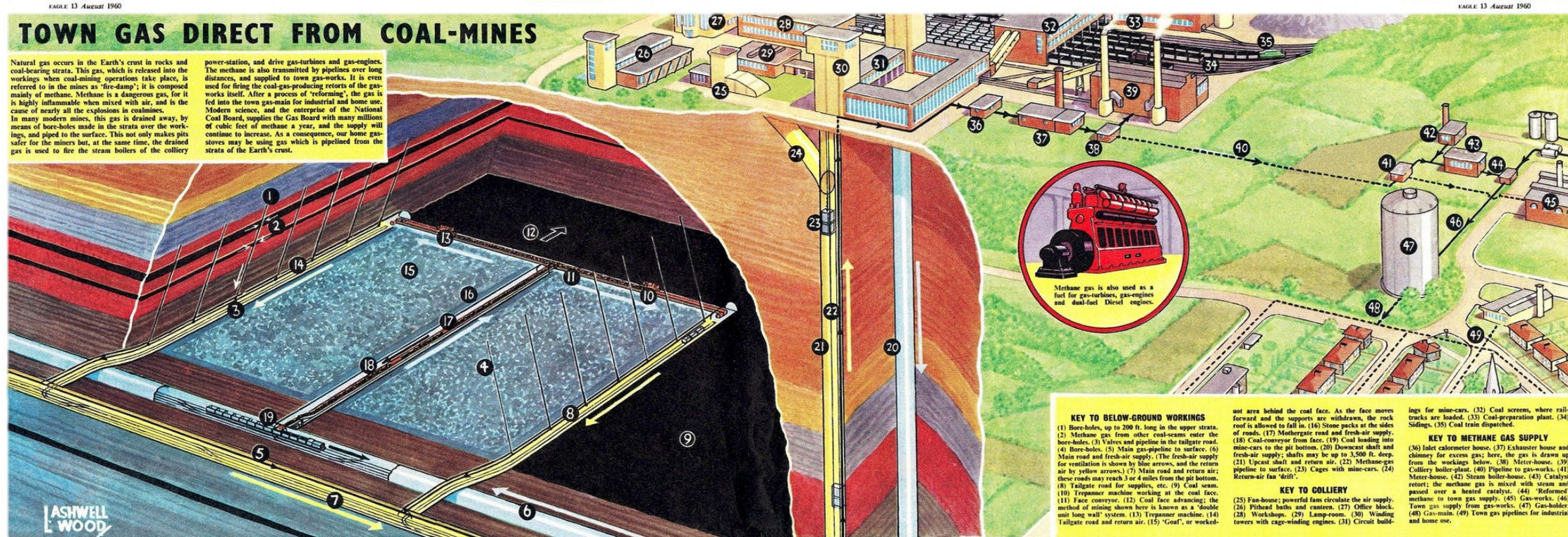
(1) Head sheave. (2) Coal bunker. (3) Machinery room. (4) Operator's cabin. (5) Remote-control coaling apron. (6) Rolling door. (7) Coal hopper wagon on wagon road. (8) Locomotive in position on coaling road. (9) Asbestos-protected metal-sheeted structure. (10) Receiving bunker. (11) Loader. (12) Bucket which is hoisted up rails (13), and tips its contents (14) into storage bunker. (15) Concrete foundations.



TOWN GAS DIRECT FROM COAL-MINES

Natural gas occurs in the Earth's crust in rocks and coal-bearing strata. This gas, which is released into the workings when coal-mining operations take place, is referred to in the mines as "fire-damp"; it is composed mainly of methane. Methane is a dangerous gas, for it is highly inflammable when mixed with air, and is the cause of nearly all the explosions in coalmines. In many modern mines, this gas is drained away, by means of bore-holes made in the strata over the workings, and piped to the surface. This not only makes pits safer for the miners but, at the same time, the drained gas is used to fire the steam boilers of the colliery

power-station, and drive gas-turbines and gas-engines. The methane is also transmitted by pipelines over long distances, and supplied to town gas-works. It is even used for firing the coal-gas-producing retorts of the gas-works itself. After a process of 'reforming', the gas is fed into the town gas-main for industrial and home use. Modern science, and the enterprise of the National Coal Board, supplies the Gas Board with many millions of cubic feet of methane a year, and the supply will continue to increase. As a consequence, our home gas-towers may be using gas which is pipelined from the strata of the Earth's crust.



KEY TO BELOW-GROUND WORKINGS

(1) Bore-holes, up to 200 ft. long in the upper strata.
(2) Methane gas from other coal-seams enter the bore-holes. (3) Valves and pipeline in the tailgate road.
(4) Bore-holes. (5) Main gas-pipeline to surface. (6) Main road and fresh-air supply. (The fresh-air supply for ventilation is shown by blue arrows, and the return air by yellow arrows.) (7) Main road and return air; these roads may reach 3 or 4 miles from the pit bottom. (8) Tailgate road for supplies, etc. (9) Coal seam.
(10) Trepanner machine working at the coal face.
(11) Face conveyor. (12) Coal face advancing; the method of mining shown here is known as a 'double unit long wall' system. (13) Trepanner machine. (14) Tailgate road and return air. (15) 'Goaf', or worked-

out area behind the coal face. As the face moves forward and the supports are withdrawn, the rock roof is allowed to fall in. (16) Stone packs at the sides of roads. (17) Mothergate road and fresh-air supply. (18) Coal-conveyor from face. (19) Coal loading into mine-cars to the pit bottom. (20) Downcast shaft and fresh-air supply; shafts may be up to 3,500 ft. deep. (21) Upcast shaft and return air. (22) Methane-gas pipeline to surface. (23) Cages with mine-cars. (24) Return-air fan 'drift'.

KEY TO COLLIERY

(25) Fan-house; powerful fans circulate the air supply. (26) Pithead baths and canteen. (27) Office block. (28) Workshops. (29) Lamp-room. (30) Winding towers with cage-winding engines. (31) Circuit build-

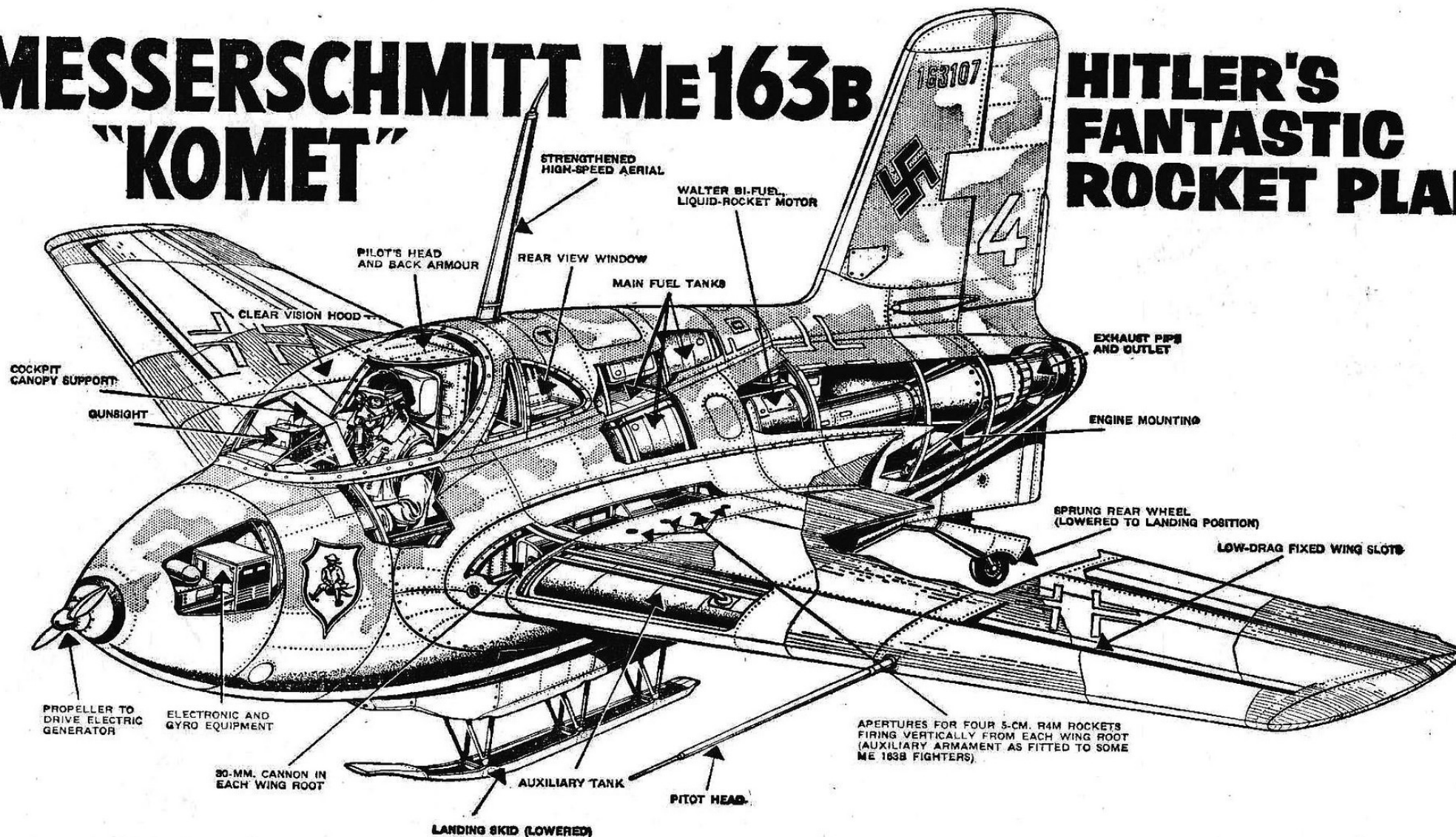
ings for mine-cars. (32) Coal screens, where rail-trucks are loaded. (33) Coal-preparation plant. (34) Sidings. (35) Coal train dispatched.

KEY TO METHANE GAS SUPPLY

(36) Inlet calorimeter house. (37) Exhauster house and chimney for excess gas; here, the gas is drawn up from the workings below. (38) Meter-house. (39) Colliery boiler-plant. (40) Pipeline to gas-works. (41) Meter-house. (42) Steam boiler-house. (43) Catalyst retort; the methane gas is mixed with steam and passed over a heated catalyst. (44) 'Reformed' methane to town gas supply. (45) Gas-works. (46) Town gas supply from gas-works. (47) Gas-holder. (48) Gas-main. (49) Town gas pipelines for industrial and home use.

MESSERSCHMITT Me163B "KOMET"

HITLER'S FANTASTIC ROCKET PLANE



THE Me 163 Komet was originally designed by Germany as a test aircraft on which various aerodynamic problems could be studied. It was planned that it should serve as a rocket motor test vehicle and for high-speed research.

The first "test bed" design, the Me 163 VI, was flown at the rocket research station at Peenemünde in 1941. It was powered by an HWK R.11 engine of 1,650 lb. thrust. During one trial, the Me 163

was towed to a height of 13,000 feet, and then cast off. The pilot fired the rocket motor and reached a speed of 623.85 m.p.h. in two minutes. This so impressed the German authorities that they proposed that the Me 163 should be developed as a rocket-propelled interceptor fighter.

Through various internal difficulties among German engineers, the Me 163, dubbed the "Komet," did not go into service until late 1944. Each group of

Komets protected an area 50 miles wide. When the enemy bombers approached, the Komets would climb until they were about 3,000 feet above their adversary, and then glide down to the attack.

The speed of the Komet caused havoc among the Allied aircraft, and for a while it was a great menace to our daylight raiders.

The Komet was powered with one Walter HWK 109-509A-2 bi-fuel, liquid-rocket motor developing 3,750 lb. thrust.

It had a maximum speed of 596 m.p.h. at 30,000 feet, and 515 m.p.h. at sea level. It had a ceiling of 54,000 feet, and its endurance after the climb was about 2½ minutes. Its armament was two 30-mm. MK 108 cannon.

The development of the Komet was a fantastic achievement for Germany, and had it come earlier it might have done much to prevent the mass air attacks on Germany which caused so much damage.

A SUPERB CUTAWAY PICTURE OF THE CELEBRATED "CORSAIR" WILL APPEAR IN NEXT MONDAY'S LION. DON'T MISS IT!

FUTURE ATOMIC POWER STATION

In this exclusive *Eagle* feature we show how the use of atomic power will be applied to the generation of electricity.

Based on scientific facts, and already drawn up, this power station will be circular in shape with the atomic 'pile' or reactor in the centre. This is the 'heart beat' of the system wherein atoms of uranium 235 are exploded and the forces so created are harnessed to produce tremendous energy and heat.

This heat is used to produce steam in three sets of boilers, or heat exchangers. The six boilers to each set will supply steam to drive a turbine, which, in turn, drives a generator to produce electricity. The three turbines (only two are shown) are arranged radially round the floor of the power station and either one or all can be used independently.

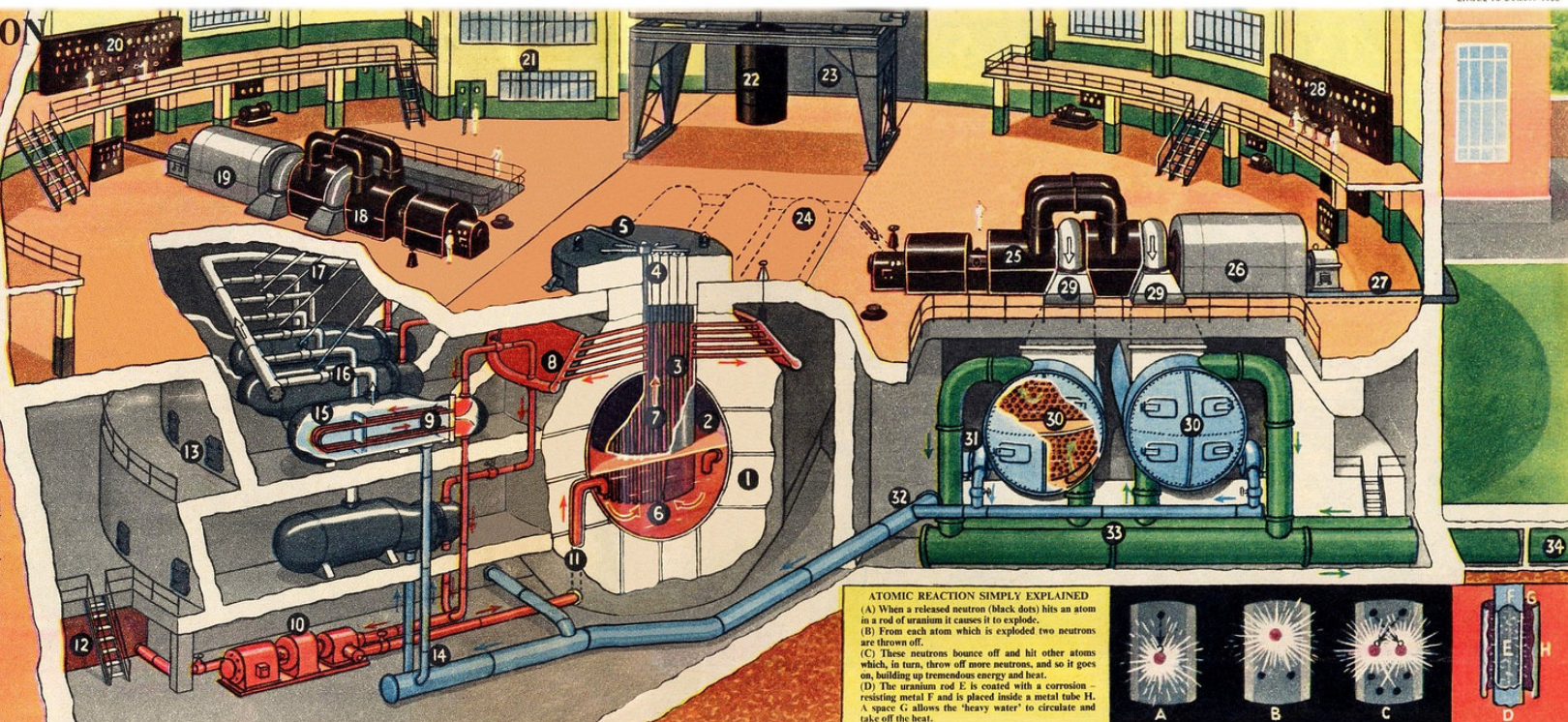
Such a power station, though costly, would do away with the huge boilers used in present day power stations and save millions of tons of coal yearly.

KEY TO HOW IT WORKS

(1) Thick concrete shield round reactor to prevent radiation. (2) Spherical atomic or nuclear reactor. (3) Tubes with rods of uranium 235 inside (the fuel). (4) Rods controlling the reactor. (5) Shielded charging door. (6) 'Heavy water', called Deuterium or D2O. This acts as a moderator for the released neutrons and also carries off the great heat. The level is maintained by interior pressure. (7) 'Heavy water' rises up between the tubes. (8) Super-heated 'heavy water' passes to the heat exchangers. (9) 'Heavy water' pipes in heat exchanger. Here the distilled water from the turbine condensers is immediately turned into steam. (10) 'Heavy water' circulating pumps. (11) 'Heavy water' returns to reactor for re-heating and so goes round and round. (12) 'Heavy water' storage tanks for replacing the supply. (13) Inspection trap doors in the heavily shielded heat exchanger chambers. (14) Distilled water supply

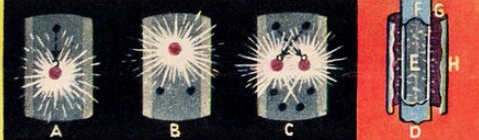
from turbine condensers. (15) Heat exchanger or boiler. There are six of these to each turbine in two banks of three each. (16) Super-heated steam pipes to turbine. (17) Steam controls from control room. (18) Steam turbine. (19) Electricity generator. (20) Switchboard. (21) Control room. Here the various temperatures and the working of the reactor is controlled, together with the steam supply and the turbines. (22) Charger containing tubes of uranium 235 for recharging the reactor when necessary. (23) Doors to uranium 235 supply the fuel. (24) Position of the set of heat exchangers supplying steam to the turbine on the right. (25) Steam turbine. (26) Electricity generator. (27) 11,000 volt cables to transformers and switch house. (28) Switchboard. (29) Exhaust steam chests to condensers. (30) Exhaust steam condensers. Here the exhaust steam is passed round the tubes of the cold circulating water and is

condensed into distilled water. (31) Distilled water pump. (32) Distilled water pipe to heat exchangers; thus the water and steam go round in a closed circuit. (This pipe, of course, should be connected to the set of heat exchangers, No. 24, belonging to this turbine, but is shown here going to the other set for the sake of simplicity.) (33) Cold water circulating pipes. (34) Circulating water pipes to control valves. This water is usually drawn from a nearby river.



ATOMIC REACTION SIMPLY EXPLAINED

(A) When a released neutron (black dots) hits an atom in a rod of uranium it causes it to explode.
(B) From each atom which is exploded two neutrons are thrown off.
(C) These neutrons bounce off and hit other atoms which, in turn, throw off more neutrons, and so it goes on, building up tremendous energy and heat.
(D) The uranium rod is coated with a corrosion-resisting metal F and is placed inside a metal tube H. A space G allows the 'heavy water' to circulate and take off the heat.



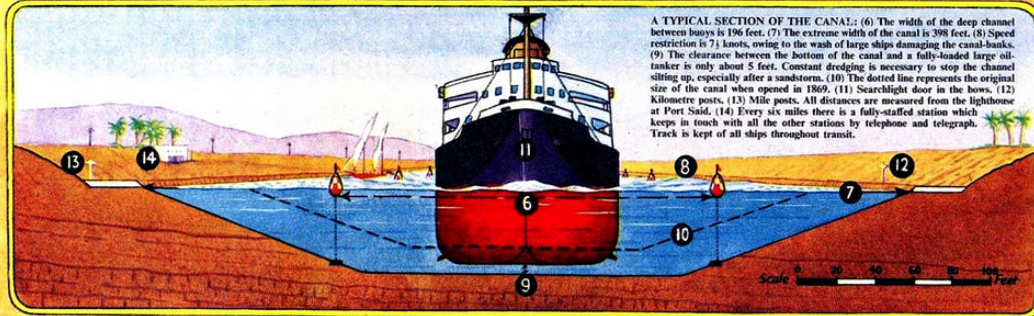
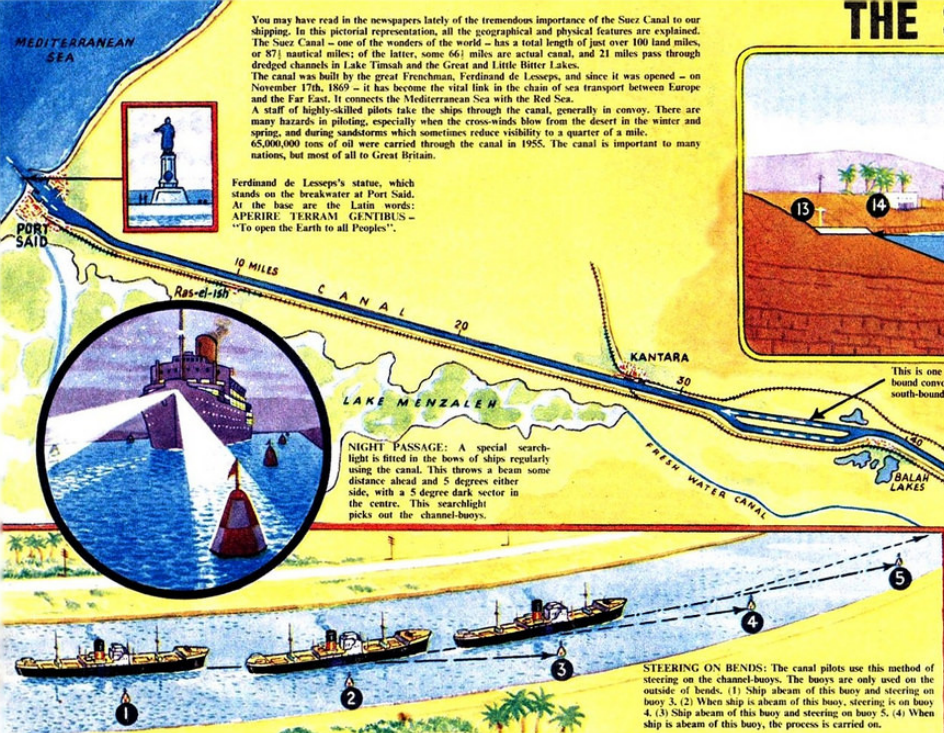
THE SUEZ CANAL—AND ITS NAVIGATION

You may have read in the newspapers lately of the tremendous importance of the Suez Canal to our shipping. In this pictorial representation, all the geographical and physical features are explained. The Suez Canal—one of the wonders of the world—has a total length of just over 100 land miles, or 87½ nautical miles; of the latter, some 66½ miles are actual canal, and 21 miles pass through dredged channels in Lake Timsah and the Great and Little Bitter Lakes.

The canal was built by the great Frenchman, Ferdinand de Lesseps, and since it was opened—on November 17th, 1869—it has become the vital link in the chain of sea transport between Europe and the Far East. It connects the Mediterranean Sea with the Red Sea.

A staff of highly-skilled pilots take the ships through the canal, generally in convoy. There are many hazards in piloting, especially when the cross-winds blow from the desert in the winter and spring, and during sandstorms which sometimes reduce visibility to a quarter of a mile. 65,000,000 tons of oil were carried through the canal in 1955. The canal is important to many nations, but most of all to Great Britain.

Ferdinand de Lesseps's statue, which stands on the breakwater at Port Said. At the base are the Latin words: APERIRE TERRAM GENTIBUS—"To open the Earth to all Peoples".



A TYPICAL SECTION OF THE CANAL: (6) The width of the deep channel between buoys is 196 feet. (7) The extreme width of the canal is 398 feet. (8) Speed restriction is 7½ knots, owing to the wash of large ships damaging the canal-banks. (9) The clearance between the bottom of the canal and a fully-loaded large oil-tanker is only about 5 feet. Constant dredging is necessary to stop the channel silting up, especially after a sandstorm. (10) The dotted line represents the original size of the canal when opened in 1869. (11) Searchlight door in the bows. (12) Kilometre posts. (13) Mile posts. All distances are measured from the lighthouse at Port Said. (14) Every six miles there is a fully-staffed station which keeps in touch with all the other stations by telephone and telegraph. Track is kept of all ships throughout transit.

This is one of the bypass points. The north-bound convoy of ships is passing on, whilst the south-bound convoy is stopped.

The canal channel is dredged in the Great Bitter Lake. In the centre, a north-bound and a south-bound convoy may pass—one of the convoys being stopped temporarily whilst the other passes.

NIGHT PASSAGE: A special searchlight is fitted in the bows of ships regularly using the canal. This throws a beam some distance ahead and 5 degrees either side, with a 5 degree dark sector in the centre. This searchlight picks out the channel-buoys.

STEERING ON BENDS: The canal pilots use this method of steering on the channel-buoys. The buoys are only used on the outside of bends. (1) Ship abreast of this buoy and steering on buoy 3. (2) When ship is abreast of this buoy, steering is on buoy 4. (3) Ship abreast of this buoy and steering on buoy 5. (4) When ship is abreast of this buoy, the process is carried on.



SHIPS IN A YEAR'S PASSAGE: A total of 14,380 ships used the canal in 1955—nearly 40 per day. Just over a quarter of these (28%) were British.

7,863 OIL TANKERS	5,234 CARGO SHIPS	1,283 PASSENGER SHIPS
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ASHWELL WOOD

BOEING 727 - TRANSATLANTIC TRIPLE JET CHALLENGER

IN December, 1960, Boeing announced the signing of contracts with two of America's leading domestic airlines, Eastern and United, for 40 new short-range jet transports each. It then became apparent that the company which enjoyed world supremacy in the

manufacture of giant jets was to challenge with its Boeing 727 Britain's attempt to capture the short-to-medium range market with the Trident, which had been ordered by British European Airways.

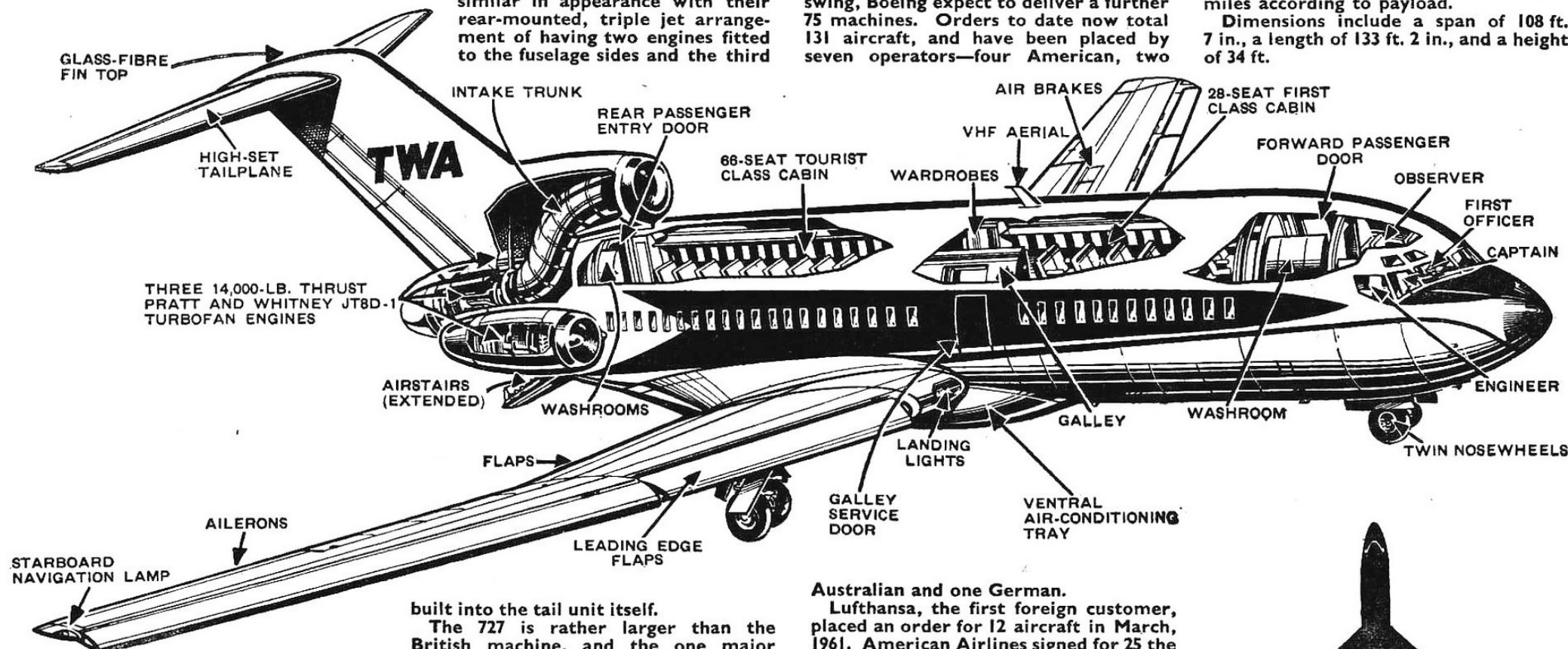
Both machines are, in fact, very similar in appearance with their rear-mounted, triple jet arrangement of having two engines fitted to the fuselage sides and the third

this year. Since that date the next three machines have all commenced flight testing, and it is hoped that first deliveries to Eastern and United will be made towards the end of the present year.

During 1964, with production in full swing, Boeing expect to deliver a further 75 machines. Orders to date now total 131 aircraft, and have been placed by seven operators—four American, two

Powered by three Pratt and Whitney JT8D-1 turbofans of 14,000 lb. thrust each, the 727 has a cruising speed of 550 mph and a range of between 2,000 and 3,000 miles according to payload.

Dimensions include a span of 108 ft. 7 in., a length of 133 ft. 2 in., and a height of 34 ft.



**BADGE OF
EASTERN
AIRLINES**

built into the tail unit itself.

The 727 is rather larger than the British machine, and the one major external difference is the large ventral bulge sported by the American. Nevertheless they will prove a tricky proposition at first for all but the keenest of spotters when the two types, operated by BEA and Lufthansa respectively, enter service in Europe.

The prototype 727 made its maiden flight on 9th February of

Australian and one German.

Lufthansa, the first foreign customer, placed an order for 12 aircraft in March, 1961. American Airlines signed for 25 the following August, and this, in turn, prompted Trans World Airlines to alter their order from French-built Caravelles to ten 727s in March last year.

Finally, the two Australian operators, TAA and Ansett-ANA, announced their order for two machines each last November.

The illustration depicts a standard 727 as it might appear in the striking "arrow-head" markings of TWA.



NEXT MONDAY'S LION WILL CONTAIN A SUPER CUTAWAY PICTURE OF THE FAMOUS VICKERS VIKING. DON'T MISS IT, PALS!

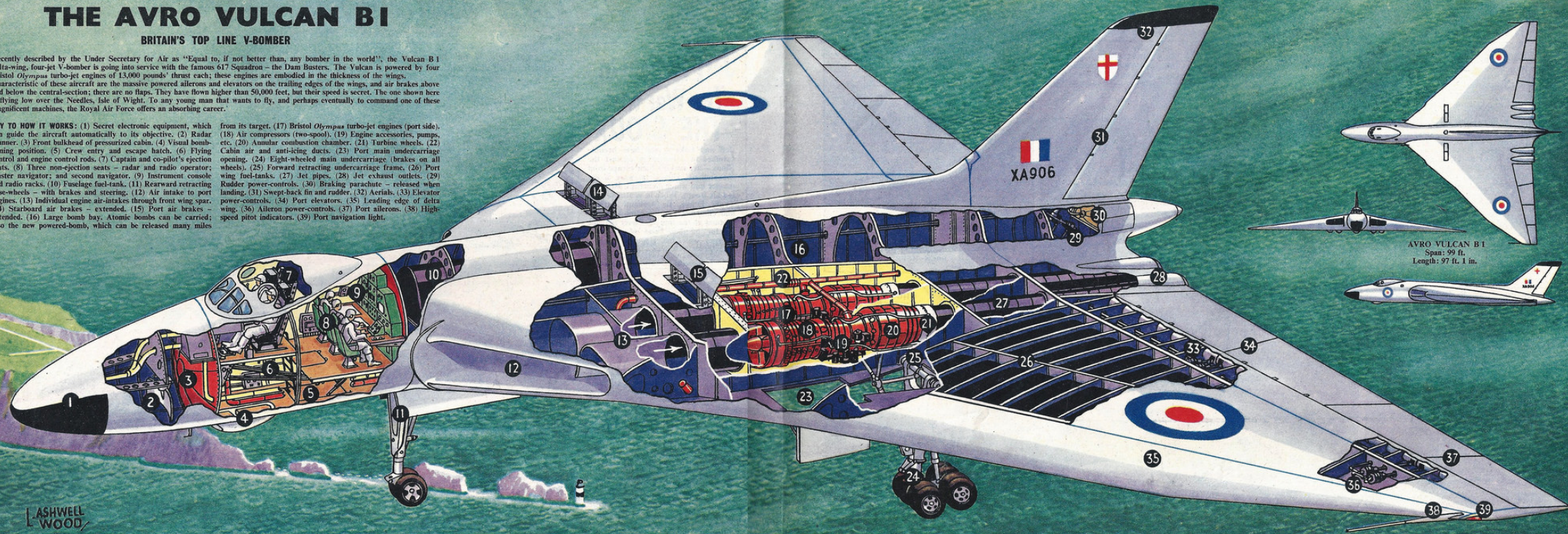
THE AVRO VULCAN B1

BRITAIN'S TOP LINE V-BOMBER

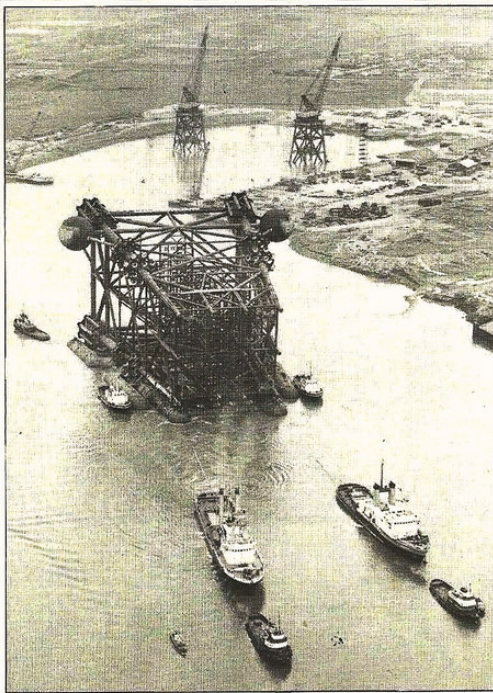
Recently described by the Under Secretary for Air as "Equal to, if not better than, any bomber in the world", the Vulcan B1 delta-wing, four-jet V-bomber is going into service with the famous 617 Squadron - the Dam Busters. The Vulcan is powered by four Bristol *Olympus* turbo-jet engines of 13,000 pounds' thrust each; these engines are embodied in the thickness of the wings. Characteristic of these aircraft are the massive powered ailerons and elevators on the trailing edges of the wings, and air brakes above and below the central-section; there are no flaps. They have flown higher than 50,000 feet, but their speed is secret. The one shown here is flying low over the Needles, Isle of Wight. To any young man that wants to fly, and perhaps eventually to command one of these magnificent machines, the Royal Air Force offers an absorbing career.

KEY TO HOW IT WORKS: (1) Secret electronic equipment, which can guide the aircraft automatically to its objective. (2) Radar scanner. (3) Front bulkhead of pressurized cabin. (4) Visual bomb-aiming position. (5) Crew entry and escape hatch. (6) Flying control and engine control rods. (7) Captain and co-pilot's ejection seats. (8) Three non-ejection seats - radar and radio operator; master navigator; and second navigator. (9) Instrument console and radio racks. (10) Fuselage fuel-tank. (11) Rearward retracting nose-wheels - with brakes and steering. (12) Air intake to port engines. (13) Individual engine air-intakes through front wing spar. (14) Starboard air brakes - extended. (15) Port air brakes - extended. (16) Large bomb bay. Atomic bombs can be carried; also the new powered-bomb, which can be released many miles

from its target. (17) Bristol *Olympus* turbo-jet engines (port side). (18) Air compressors (two-spool). (19) Engine accessories, pumps, etc. (20) Annular combustion chamber. (21) Turbine wheels. (22) Cabin air and anti-icing ducts. (23) Port main undercarriage opening. (24) Eight-wheeled main undercarriage (brakes on all wheels). (25) Forward retracting undercarriage frame. (26) Port wing fuel-tanks. (27) Jet pipes. (28) Jet exhaust outlets. (29) Rudder power-controls. (30) Braking parachute - released when landing. (31) Swept-back fin and rudder. (32) Aerials. (33) Elevator power-controls. (34) Port elevators. (35) Leading edge of delta wing. (36) Aileron power-controls. (37) Port ailerons. (38) High-speed pitot indicators. (39) Port navigation light.



LASHWELL
WOOD



INSIDE STORY

The Rock-Biter

A drilling bit that bites its way through subterranean rock in the search for oil is an essential part of a rig

LAST year, oil production from the North Sea amounted to nearly half of Britain's oil consumption. By June this year it had topped the one million barrels a day mark (a barrel is 35 gallons or 159 litres). And, according to some estimates, Britain should be getting all the oil it needs from the North Sea by 1980.

Extensive exploration, seismic tests, drilling and the sinking of test wells followed by production platforms have made this possible.

The earliest marine drilling rig was a simple wooden-pile platform. Twenty-five years later came the drilling barge which floated to the drilling area and submerged to rest on the sea bed.

From this, two types were developed, one resting on the sea floor and the other with legs incorporating a jacking system so that the barge can be raised

well clear of the water during drilling operations.

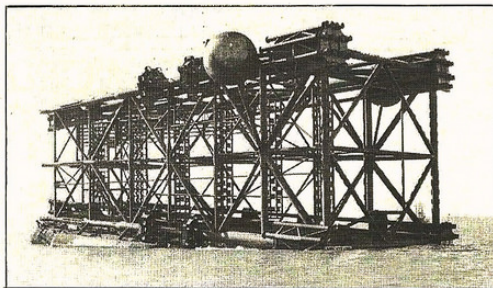
A floating drilling unit has been developed which is able to operate in any depth of water. Remote control tools and techniques have been evolved for completing and controlling wells on the sea bed. These include an undersea robot that does the work of a diver.

Drilling is done by a bit at the end of lengths of drill pipe screwed together. This is rotated by a powerful motor. As the bit descends, a new length of pipe is added.

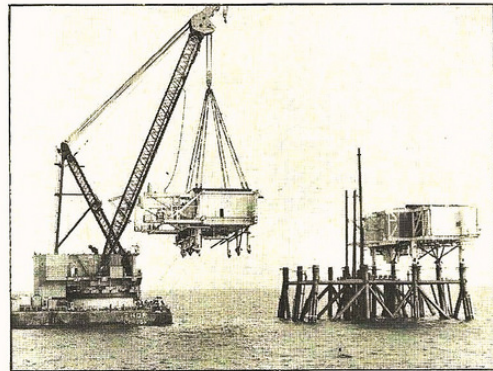
Escaping natural gas is channelled to a flare stack where it is burnt off so that its quality, quantity and pressure can be ascertained.

Rigs like the one in our picture were used to develop a gas field off the Yorkshire coast, and the Forties oil field 180 kilometres off the coast of Aberdeen.

They are also being used in a new field west of the Shetland Islands. This is thought to contain far more oil than the Forties Field, which is expected to yield around two billion barrels.



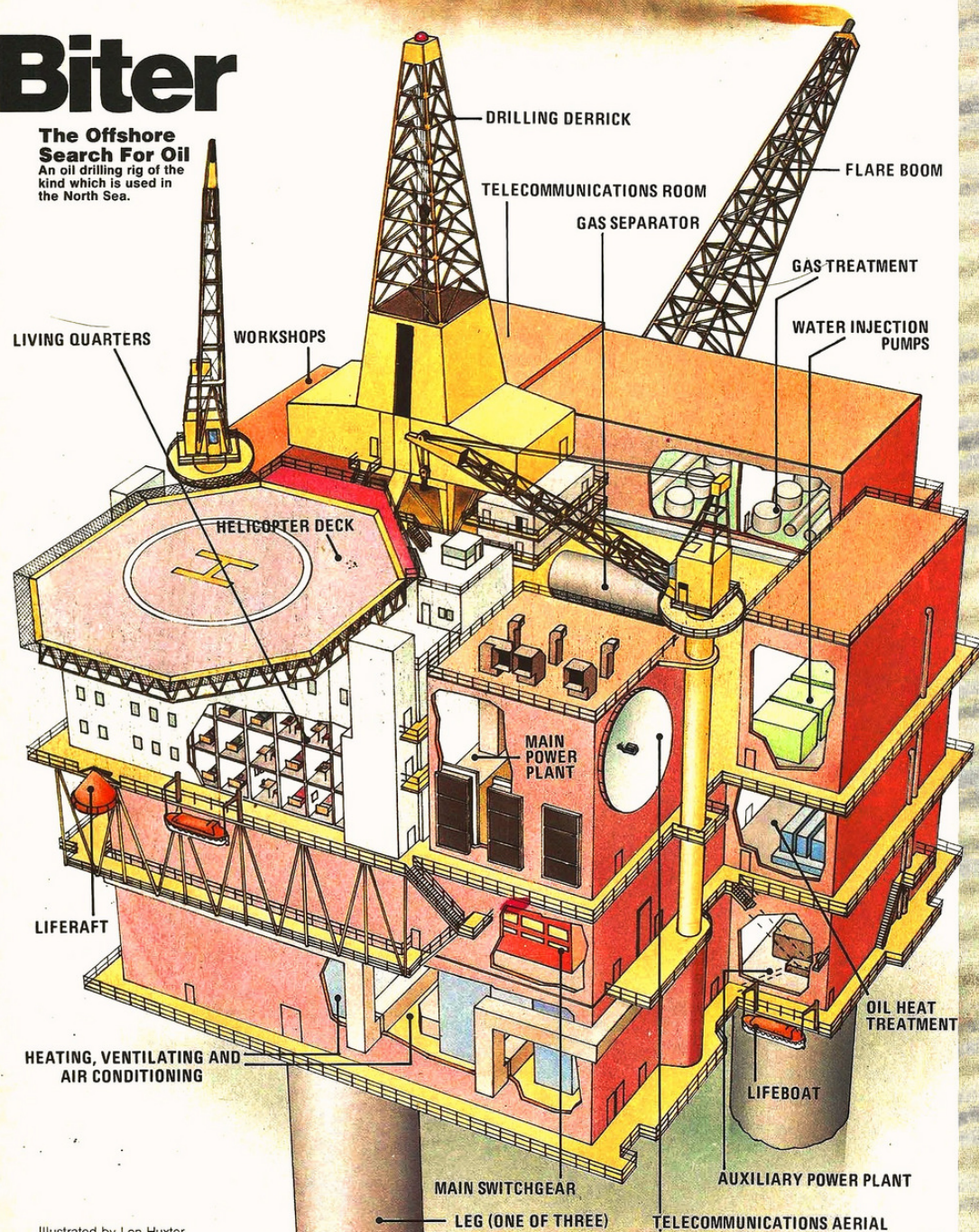
After being constructed at Graythorp, near Hartlepool, Durham, the production platform, Graythorp I, was towed down the Seaton Channel (top) and out to the North Sea (above) where it was sunk to the seabed by the flooding of its buoyancy tanks.



Once the platform was in position, the superstructure was lifted on to it by a crane-barge. Subsequently, equipment like that seen in our big picture, but without the drilling apparatus, was fitted.



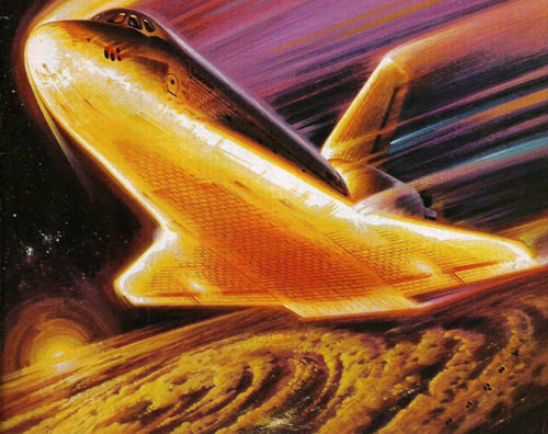
The Offshore Search For Oil
An oil drilling rig of the kind which is used in the North Sea.



Illustrated by Len Huxter

GREAT BALLS OF FIRE

READ ABOUT THEM INSIDE



Speed & Power

Although their interiors should be comfortably cool, thanks to the use of a heat-resistant covering, the space shuttles of the future will glow with a fiery intensity

GREAT BALLS OF FIRE

"PREPARE for earth-atmosphere re-entry," crisply ordered the commander of the space shuttle.

The scientists returning to Earth after a spell of duty in an orbiting space laboratory looked at each other anxiously.

Grimly, they fastened their seat belts and steeled themselves for the tremendous pull of the Earth's gravity.

Even more frightening was the fact that as their shuttle hurtled at an incredibly fast speed into the mixture of gases that surround the Earth, the exterior skin of their shuttle would become a ball of fire, more intensely hot than the hottest furnace.

Officials at the North America Space Administration headquarters were tracking the shuttle on their radar screens. A mass of technical information from the shuttle was fed to a myriad of dials. The one that attracted a lot of attention

Close-up of the orbiter nose shows the pattern of tiles that act as a heat shield and protect the craft from the effect of the high temperatures that are created as it speeds through the Earth's atmosphere. The craft's contours complicate the task of fitting the tiles together.

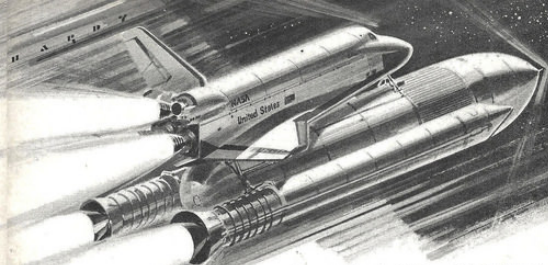
was a temperature indicator. It showed how hot it was on the skin of the craft and how hot it was inside where, if the thermal protection failed, the scientists could be roasted alive.

But the NASA officials were not all that worried. They were pinning their faith on a coating of heat-resistant tiles that covered the outer casing of the shuttle. As the shuttle raced through the air, the friction between it and the atmosphere created the incredibly intense heat that the scientists anticipated.

However, inside the shuttle the passengers felt warm, but not uncomfortably so. And when their shuttle landed like a conventional jet plane, they stepped out, glad to be home and physically unharmed by the experience they had been through.

Amazing? Incredible? Of course! But scenes like this could become regular occurrences in years to come, when shuttles are shot off to space laboratories on the back of a rocket and brought back to earth like a returning capsule — but with wings with which they can land on a runway.

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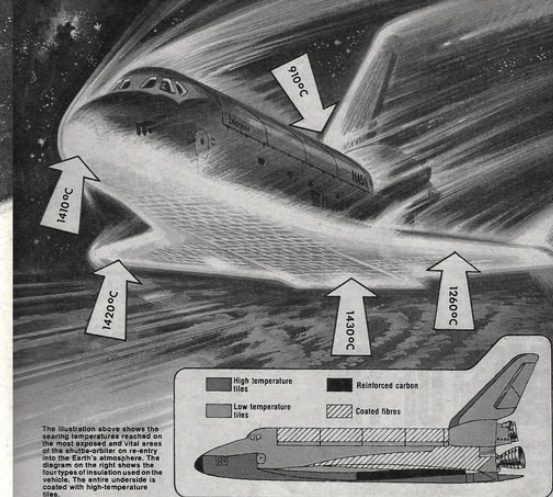
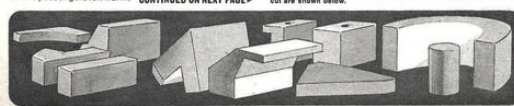


The space shuttle blasts into orbit on its massive fuel tank with solid fuel booster rockets attached. In some cases should any yaw (sideways movement of the nose) develop, the temperatures reached on some parts of the shuttle could be higher than those attained on its re-entry into the Earth's atmosphere.

White hot, the glow from the silica materials of which the tiles are made lights up the face of the technician in the darkened furnace room. Heat is lost so quickly that his bare fingers are not injured.



Some of the many thousands of different shapes into which the tiles are cut are shown below.



The illustration above shows the searing temperatures reached on the most exposed and vital areas of the shuttle-orbiter on re-entry into the Earth's atmosphere. The diagram on the right shows the four types of insulation used on the vehicle. The entire underside is coated with high-temperature tiles.

The problem has been to provide the shuttle with a protective skin that can stand up to a hundred re-entries without failing.

After many experiments, America's Lockheed company made some tiles which could be fastened to the exterior of the shuttle. They are designed to lose their surface heat very rapidly so that they do not convey it, by conduction, to the shuttle's shell. These tiles can withstand repeated heating and cooling without damage. They can be taken away from a kiln and plunged into cold water without coming to harm. And it is possible to hold one with the bare fingers without injury while it is

still glowing white hot after being heated in an oven. The basic raw material for the tiles is sand, from which are made the silica fibres that compose the tiles.

A cement containing the fibres is mixed with water and a binder, and cast into soft, porous blocks. Tiles are cut from these blocks, coated with a silica mixture and then baked.

Tiles for the underside of the shuttle receive a glass coating that can resist very high temperatures. Those intended for the upper surfaces have a white shiny surface intended to reflect the sun's rays and keep the shuttle cool while in orbit.

A waterproofing compound is added to prevent the tiles from absorbing extra weight in rain or humidity.

Cutting the tiles to fit the complex shape of a space shuttle is so complicated that no two tiles are exactly alike. Computer-controlled milling machines are used to cut them. Fitting them on to the space craft could be as tricky as assembling a jigsaw puzzle twice the size of a tennis court.

To further complicate matters, the small gaps between the tiles — from where air trapped by the tiles is allowed to escape to prevent expansion — must be uniform to within a very small margin.

Nearly 34,000 tiles will be used to cover about 70 per cent of the aircraft's surface. When the first shuttle travels in space it will be after a succession of tests carried out with the shuttle on the back of a carrier craft. At first it will be unmanned. Manned, pick-back flights will follow and then, in July this year, the shuttle is expected to separate from its carrier for the first time and glide back to earth.

If these are considered successful enough for the shuttle to be put into orbit, the covering of tiles will be applied and the shuttle will take-off into space and herald a new phase in the exploration of the unknown.

THE WORLD OF SPEED AND POWER

Illustration by Wilf Hardy

Five turbine engines, 48 separate air cushions and five years' technical study have all gone into the latest...

CROSS-CHANNEL GIANT

HOVERCRAFT — or Air Cushion Vehicles (ACVs) as they are sometimes called — are now firmly established as one of the world's successful forms of transport, and one which is particularly useful for short-haul work, where medium-sized loads need to be carried quickly across stretches of open water.

One route on which hovercraft have been tried and tested with considerable success for a number of years is the cross-Channel journey between Britain and France, where the world's first ACV car-carrying service began in August, 1968. Seaspeed, a subsidiary of British Rail, started the service with a giant Mountbatten Class hovercraft called *The Princess Margaret*, and followed it up a year later with a second one — *The Princess Anne*.

Between them, these two hovercraft have ferried five million passengers and about 775,000 cars across the English Channel between Dover and Calais, and Dover and Boulogne. Now, a super-sized hovercraft — the biggest in the world — will be coming into service during the summer of 1978.

This is the 240-tonne Sedam N-500, a French-built ACV, which will be able to carry up to 400 passengers and 65 cars, more than double the load carried by the standard Mountbatten Class. It will also be able to carry five coaches on a raised central section.

The N-500 "Naviplane", as the French call it, is the result of five years' technical study and six months' technical trials. Fifty metres in length and 23 metres wide, it is the first of an entirely new generation of hovercraft and differs greatly from the existing British Mountbatten Class.

Although they are fast — the N-500 will reach 70 knots on fairly calm days — hovercraft have some disadvantages. They can be difficult to steer in a strong side-wind, and they throw up a lot of spray which blocks the passengers' view.

New Cushion System

The designers of the N-500 have dealt with these two problems by fitting a completely new type of air cushion. Instead of using one huge single "skirt", they have built 48 separate cylindrical skirts, each of which has a separate air supply. Complicated pipework supplies air to groups of cushions, and the pressure can be altered by the pilot to adjust pitch and roll to suit the weather conditions.

Five engines power the N-500: two provide lift, and three are for propulsion. The forward propulsion engines are mounted on a gantry high above the water. As they are directly connected to their propellers instead of through drive-shafts like those of the

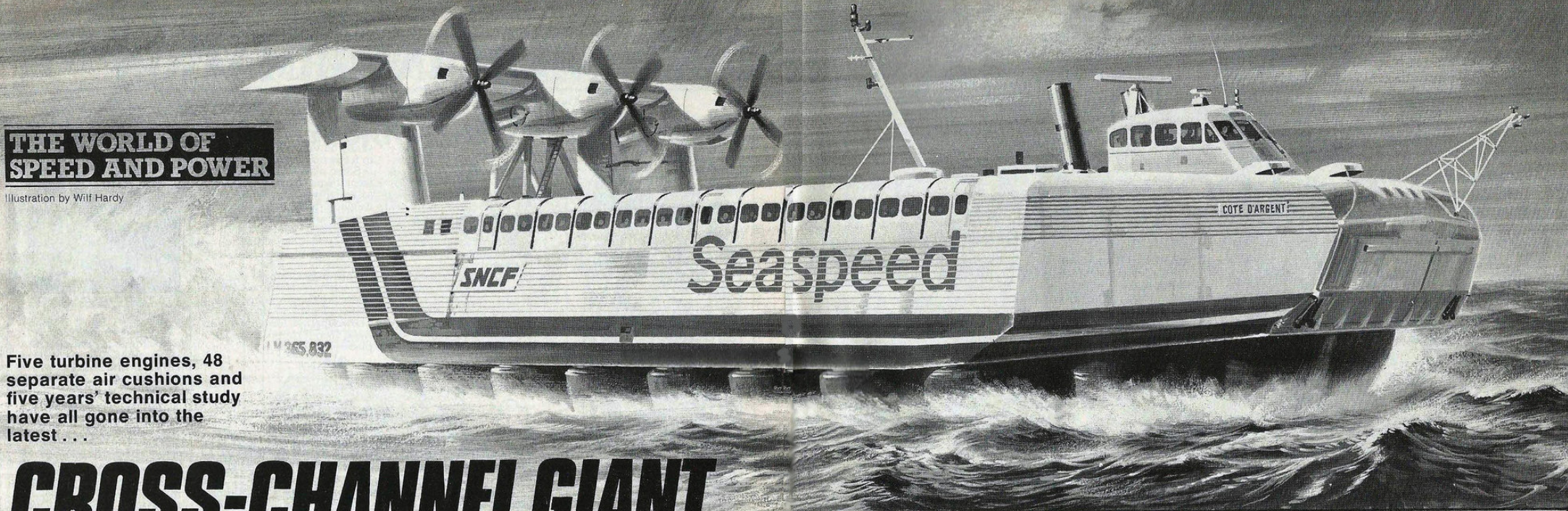
Mountbatten Class, there is a considerable reduction in noise and vibration.

The engines are Mariniised Lycoming TF 40 turbines with a maximum continuous horsepower of 16,000. The drive propellers are made by the British Hawker Siddeley company and are 6.4 metres in diameter. Their pitch can be varied, and even reversed, to increase manoeuvrability. The passenger deck is also higher above the waterline than in any other hovercraft, so increasing visibility.

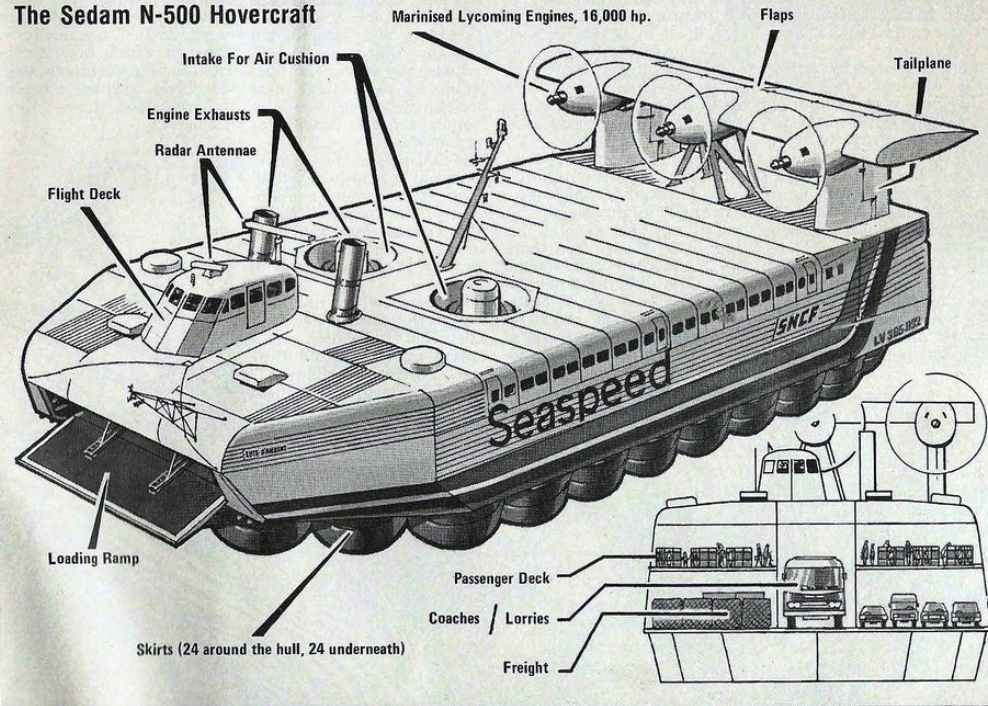
The N-500, which belongs to SNCF, the nationalised French railway system, will operate in conjunction with Britain's Seaspeed hovercraft which are themselves undergoing a complete transformation.

The two SRN4s are to be cut in half, and a 16.5 metre new centre section fitted which will increase their overall length to 55.5 metres.

In addition to lengthening the Mountbatten Class hovercraft, the rebuilding will also involve the realignment of the transmission system, the redesigning of the inner cabins and the fitting of additional seats. The Proteus jet engines will be uprated to 3,800hp, and new propeller pylons will be fitted. The "stretched" hovercraft will be able to carry 416 passengers and up to 60 cars, thus matching the capacity of the French N-500.



The Sedam N-500 Hovercraft



HAVE GUN-

ON 26th May this year, the Royal Artillery celebrated its 250th Anniversary. Over the whole of this period, the R.A. has amassed battle honours wherever they have fought. Keeping in line with the other services, the Army has become a highly-technical force with equipment second to none.

Instead of towing its guns behind lorries, the R.A. is more and more turning to self-propelled weapons backed up by vehicles such as the Stalwart (EAGLE cutaway, 2nd January, 1965) and new tracked supply vehicles which are able to travel over the worst country.

When the R.A. required a gun in the region of 175 mm. for long-range battery work, the best available was the American M.107 and now units are receiving this very powerful weapon.

SPECIFICATION

Weight: 25 tons 14 cwt.
Dimensions:
Length: (gun in travelling position)
37 ft. 0½ in.
Height: (gun in travelling position)
11 ft. 5 ins.
Width: 10 ft. 4 ins.
Performance:
Max. speed: 34.4 m.p.h.
Reverse: 7.1 m.p.h.
Range: 450 miles.
Consumption: 1.8 m.p.g.
Turning radius: 12 ft.
Fording depth: 3.6 ft.

WILL TRAVEL!

AN EAGLE
cutaway
DRAWING

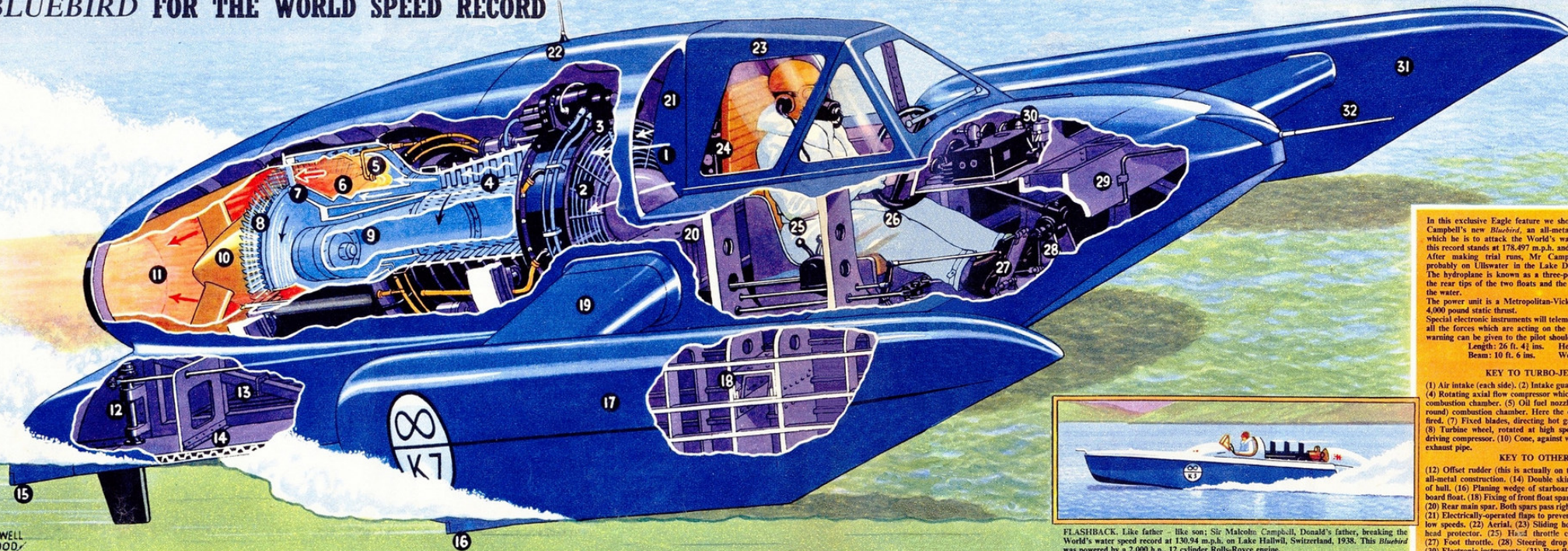


spring lock. The suspension is locked when the gun fires to make a firm firing platform. (6) Rubber pads set in track links make for a smooth ride. (7) Rear trailing idler wheel. (8) Fuel tank holds 250 gallons of Diesel fuel. (9) 175 mm. (6.9 in.) high-velocity gun. Barrel length, 35 feet 8 ins. Weight of gun alone: 6 tons 3½ cwt. Hydro-pneumatic recoil take up. Range, 20.3 miles. Muzzle velocity, 3,000 feet per second. (10) Equilibrators for balancing gun. (11) Travel lock. (12) Sights: There are several variations of sights for long- and close-range work set up on both sides of the gun. (13) Traverse handle. The gun will traverse 30 degrees on either side of centre. (14) Gun layer's seat (both sides). (15) Manual elevating gear and elevation control handle in case hydraulics are damaged. (16) Electric oil pump motor. (17) Gun mounting. (18) Turntable. (19) Breech block shown open. Firing mechanism is in this part. (20) Hydraulic loading gear control panel. (21) Loading tray and hydraulic rammer for placing 174-lb. shell 'up the spout'. (22) For travelling, this rammer and loading gear swings back on a pivot which is attached to the left gun mounting. Movement of a couple of small levers causes it to fold itself up and swing neatly out of the way. The gun itself then moves back 54 inches. (23) Loader arms. The N.C.O. or officer in charge of the gun and at the controls operates these arms. The arms swing over the back of the vehicle where further crew members are receiving shells from the 'back-up' vehicle. They put them in the swinging frame. Once in the frame, the arms swing the shell over, past the position shown dotted, and down on to the loading tray where the rammer feeds it into the breech. Another crew member, most likely the driver, pushes in by hand the cordite bags which propel the shell. (24) 174-lb. shell on loading frame. (25) Recoil spade. By digging this into the ground and then backing up, the enormous recoil is taken up. This hydraulic spade can also be used to dig a hole into which the vehicle can drive. (26) Fixed spade braces. (27) Hydraulic spade lifting cylinders. (28) Only two shells are carried on the gun itself, just in case it gets in a fix and needs some defence. (29) Towing hook. (30) Bracket to take 4 rifles of crew members. (31) Spare crew travelling seat. Some have them on other side. (32) Hand-grenade box. (33) Stop and tail lights. (34) Headlights and horn (both sides).

KEY TO NUMBERED PARTS

(1) Engine: General Motors 8V71T 420 B.H.P. 8-cylinder, liquid-cooled, turbo-charged, 2-stroke Diesel. (2) Through an Allison gearbox, the power goes to this transmission pack. (3) Final drive sprocket. (4) Exhaust ports. (5) Hydraulic cylinder on each wheel acts as a spring, shock absorber, suspension stop and

BLUEBIRD FOR THE WORLD SPEED RECORD



In this exclusive Eagle feature we show, for the first time, Donald Campbell's new *Bluebird*, an all-metal, jet-driven hydroplane with which he is to attack the World's water speed record. At present, this record stands at 178.497 m.p.h. and is held by America. After making trial runs, Mr. Campbell will attack the record probably on Ullswater in the Lake District of England. The hydroplane is known as a three-pointer; that is, at speed, only the rear tips of the two floats and the hull will be actually touching the water.

The power unit is a Metropolitan-Vickers *Beryl* turbo-jet engine of 4,000 pound static thrust.

Special electronic instruments will telemeter by radio to a shore station all the forces which are acting on the hull at speed, so that audible warning can be given to the pilot should he approach a danger point.

Length: 26 ft. 4½ ins. Height: 4 ft. 8½ ins.
Beam: 10 ft. 6 ins. Weight: 2½ tons.

KEY TO TURBO-JET ENGINE

(1) Air intake (each side). (2) Intake guard. (3) Electric starting motor. (4) Rotating axial flow compressor which forces compressed air to the combustion chamber. (5) Oil fuel nozzle (20 in all). (6) Annular (all round) combustion chamber. Here the oil fuel is mixed with air and fired. (7) Fixed blades, directing hot gases on to the turbine blades. (8) Turbine wheel, rotated at high speed. (9) Hollow turbine shaft driving compressor. (10) Cone, against which jet thrust reacts. (11) Jet exhaust pipe.

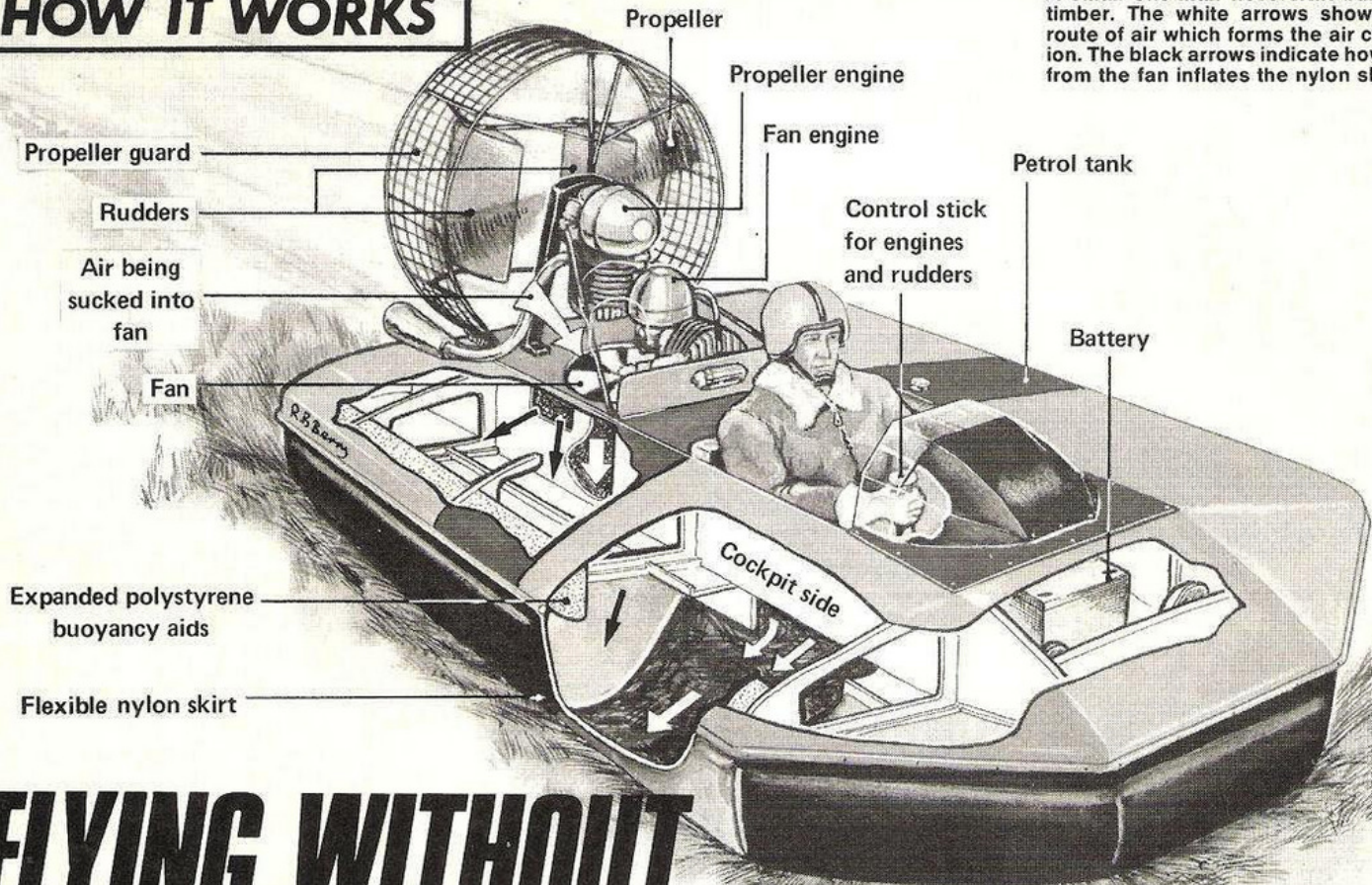
KEY TO OTHER PARTS

(12) Offset rudder (this is actually on the port side). (13) All-welded all-metal construction. (14) Double skin bottom. (15) Planing wedge of hull. (16) Planing wedge of starboard float or sponson. (17) Starboard float. (18) Fixing of front float spar. (19) Rear float spar covering. (20) Rear main spar. Both spars pass right through the hull for strength. (21) Electrically-operated flaps to prevent water entering the engine at low speeds. (22) Aerial. (23) Sliding hood. (24) Radio behind pilot's head protector. (25) Hand throttle controls. (26) Steering wheel. (27) Foot throttle. (28) Steering drop arm. (29) Front main spar. (30) Electronic instruments. (31) Port float. (32) Pitot head.

FLASHBACK. Like father - like son; Sir Malcolm Campbell, Donald's father, breaking the World's water speed record at 130.94 m.p.h. on Lake Hallwil, Switzerland, 1938. This *Bluebird* was powered by a 2,000 h.p., 12 cylinder Rolls-Royce engine.

HOW IT WORKS

A small one-man hovercraft built of timber. The white arrows show the route of air which forms the air cushion. The black arrows indicate how air from the fan inflates the nylon skirt.



FLYING WITHOUT WINGS

It isn't a plane, a car or a boat. And it hasn't got wheels or wings. Yet it can travel over water or land without touching either. What is it?

There is only one thing it could be, and that is a hovercraft which floats on a cushion of air.

Whether it is the small one-man vehicle above or the large car and passenger ferry on the right, all hovercraft run on the same principle.

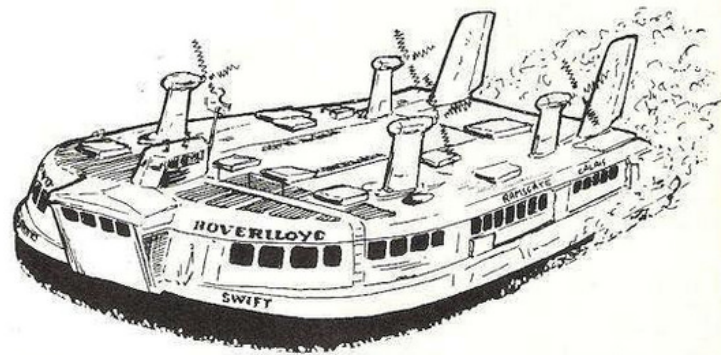
Fans suck in air and force this out through vents beneath the

vehicle, where it is prevented from escaping by a strong skirt that surrounds the craft.

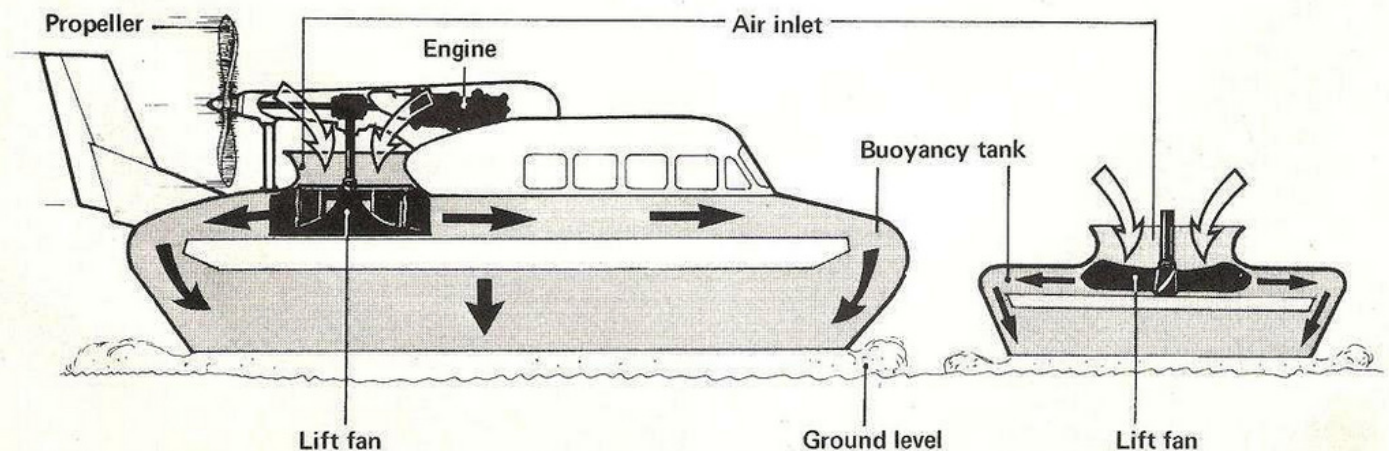
In this way, a dense cushion of air is formed which raises the craft clear of the ground, thus obviating any friction.

Propellers drive the hovercraft along. The pitch and direction of these can be altered for steering.

Invented by Sir Christopher Cockerell in 1954, the first hovercraft "flew" in 1959, with the first public service being introduced in 1962.



Thirty cars and 254 people are carried by the cross-Channel (Ramsgate to Calais) hovercraft above. Bottom left: the layout of a small passenger craft. Bottom right: how air is drawn in and driven downwards by the centrifugal fan to form a cushion of air beneath the craft.



HAMILCAR

A flying tank which could have dropped out of the skies into the thick of battle was the dream of inventors in World War II. But it was too far-fetched to be practicable. As a substitute, the designers produced the Hamilcar wooden glider. It was specially conceived to carry the seven-ton Tetrarch tank and deliver it straight to the battlefield from the air. The first models had undercarriages which could be dropped after take-off. But later versions were built with undercarriages which collapsed after the pilot had manoeuvred his glider into a good position on the ground. The tank could then be run out of the glider and taken to the part of the fighting where its presence was most needed.



**TANK-CARRYING
GLIDER**

BATTLE
**MASTER
PLAN**
No. 16

BATTLE MASTER PLAN

No. 9

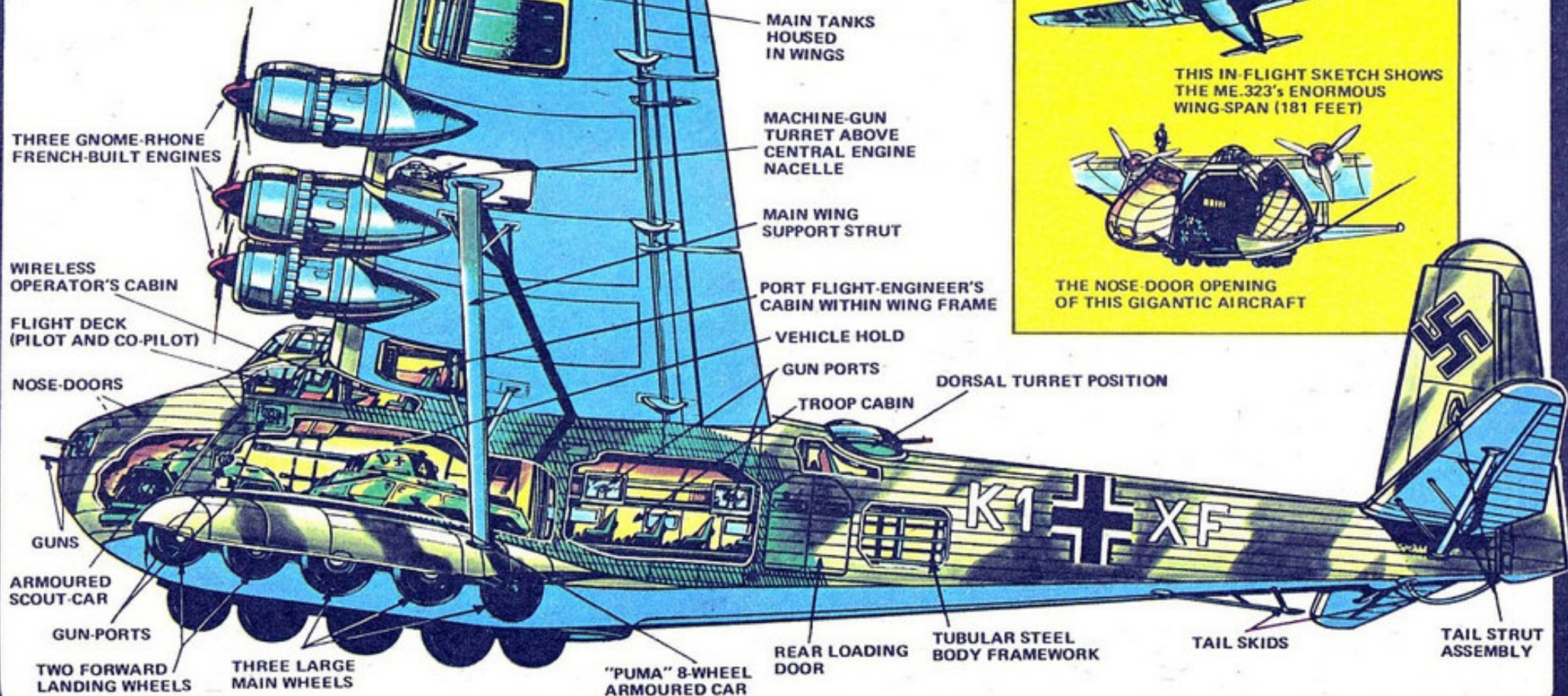
MESSERSCHMITT ME. 323

This monster military plane was the biggest aircraft flown in World War II and proved a valuable asset to the German offensive against Russia.

Its gigantic hold could carry an anti-aircraft gun, two trucks, 130 troops, fifty-two drums of fuel and still have room for over sixty stretcher

cases.

Six powerful engines were needed to lift this awesome giant into the air, and the sight of the 323, with its huge wingspan of 181 ft. and over-all length of 93 ft. 4 ins. was a great moral-boosting sight to the German forces on the ground.



BATTLE
**MODERN
MASTER
PLAN**
No. 13

FV.180 Combat Tractor

It looks like a tank, has armour just like a tank, and is driven on tracks in the same way that a tank is — and yet there is one essential difference: this British FV.180 has no weapons! In fact, it is not a tank at all, but a combat engineer tractor and it could prove to be a most useful front-line "jack of all trades" for the British Army. For example, it has a bucket-scoop at the back, like a bulldozer's, which it uses to make a passable track through trees or over rough ground so that vital supplies can be taken by track to the fighting troops. This scoop can be used to prepare airstrips, dig out gun sites, lay stores along the battlefield and pile rubble barricades or obstacles to halt an advancing army. The combat tractor also has a winch at the front which can be used to uproot a stubborn tree-trunk or tow damaged vehicles from the path of friendly tanks.

This winch has another unusual purpose. If the combat tractor gets stuck in boggy ground, or is faced with a steep river bank to climb, it fires a rocket attached to a cable and anchor into firm ground and the winch is operated to

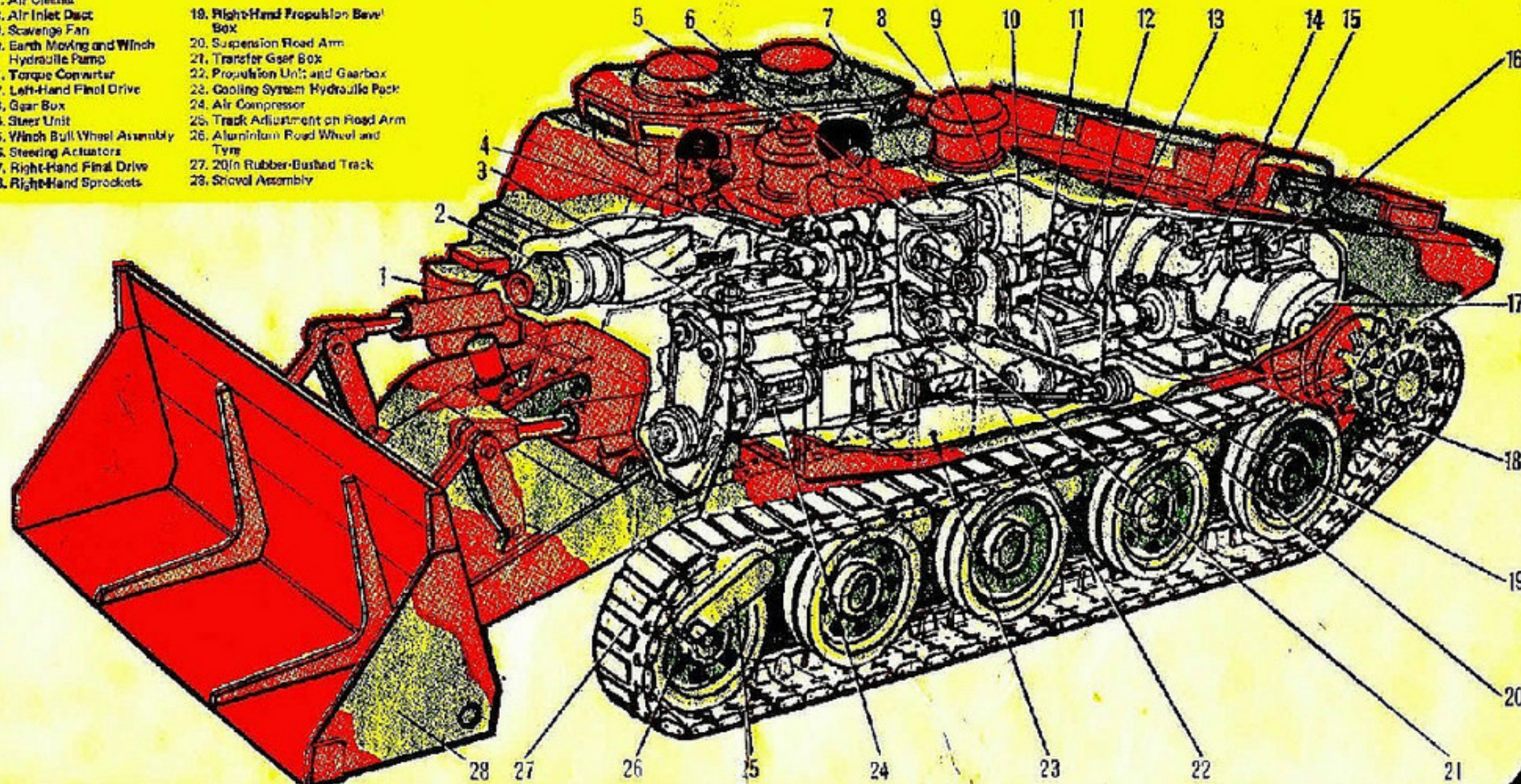
haul the vehicle out of difficulty. Many a tank has been destroyed because it has become a bogged-down sitting target, and since the FV.180 is not able to defend itself (except to lay a smoke screen) no doubt the crew are thankful for the rocket-assisted escape line!

There are two drivers, back to back, one operating the scoop and the other the winch. The front-facing winch operator normally drives the combat tractor over roads and rough ground, where it can reach up to 34mph, or across rivers which, because it is amphibious, the vehicle tackles with ease. It has two powerful rear-mounted water jets, thrusting the FV.180 through the water at about 8mph.

The combat tractor is 24ft. 9in. long, 9ft. 6in. wide and 8ft. 6in. high. It weighs about 16 tons, but can easily be carried by air right to where it is needed so that its all-round construction ability — even laying a metal strip for tanks to cover soft ground — could mean the difference between winning and losing a battle.

1. Swimming Steering Cowl
2. Left-Hand Water Propulsion Unit
3. Engine (Diesel)
4. Turbo Charger
5. Exhaust and Scavenge Air Outlet Ducts
6. Alternator
7. Air Cleaner
8. Air Inlet Duct
9. Scavenge Fan
10. Earth Moving and Winch Hydraulic Pump
11. Torque Converter
12. Left-Hand Final Drive
13. Gear Box
14. Steer Unit
15. Winch Bull Wheel Assembly
16. Steering Actuators
17. Right-Hand Final Drive
18. Right-Hand Sprockets

19. Right-Hand Propulsion Bevel Box
20. Suspension Road Arm
21. Transfer Gear Box
22. Propulsion Unit and Gearbox
23. Cooling System Hydraulic Pack
24. Air Compressor
25. Track Adjustment on Road Arm
26. Aluminium Road Wheel and Tyre
27. 20in Rubber-Bushed Track
28. Sprocket Assembly



THE BUSY 'SEABEES'

DESPITE the tremendous advances made in the size and efficiency of aircraft during the last half century, and their ability to carry both people and cargo rapidly over long distances, it is still one of man's earliest forms of transport—the ship—that remains the most economical means of bulk transport.

Moving things by sea does, of course, take much longer, because, although modern ships can travel faster than the early merchantmen, and have reduced the time taken for some journeys from weeks to days, a great deal of time is still involved in loading and unloading material at docks and harbours.

The ideal situation for a shipping company is to have a vessel capable of handling massive loads of around 2,000 tons unaided, and able to operate independently of any port facilities, so that it does not need to become involved in the time-consuming process of loading and unloading by the usual methods of cranes and barges.

Today, such vessels do exist, and a

Cargo carriers with a difference are the Seabees whose storage holds are as compact as a beehive with their orderly stowage of freight-carrying barges

number of them ply regularly between ports in the Gulf of Mexico and western Europe. They are called Seabees, and are the result of a brainwave by a man named Frank A. Nemeo of the American shipping company, Lykes Lines, which has its headquarters in the port of New Orleans, Louisiana, U.S.A.

Frank Nemeo realised that most of the cargo for their ships reached them by means of barges which had been towed down the mighty Mississippi and Missouri rivers. On arrival, the contents of the barges had to be labori-

ously transferred to the holds of his ships. Then, after the sea voyage the whole process had to be reversed.

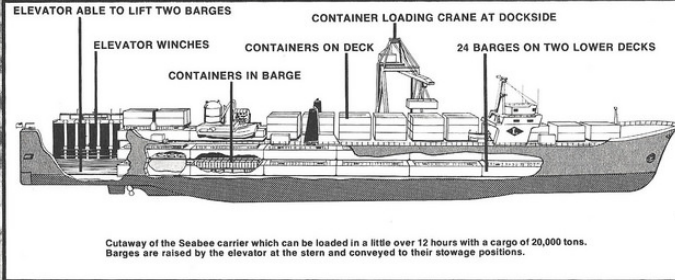
Why not, thought Frank Nemeo, have a ship into which whole barges could be loaded and unloaded, thus saving days of expensive waiting around ports? The Seabee ships are the outcome of this bold and imaginative idea.

You may remember reading about them in our 2nd July issue. An article entitled 'The Piggy-Back Barge Carriers' described various types of ships which sailed with barges stowed on their decks and in their holds. One of them, the Seabee, was mentioned briefly then. We thought readers would like to know more about it.

Each Seabee can accommodate 38 specially designed box-shaped steel barges with a carrying capacity of 850 tons. The barges are not just 'containers' but are so constructed that they can be towed through the water like any other river barge.

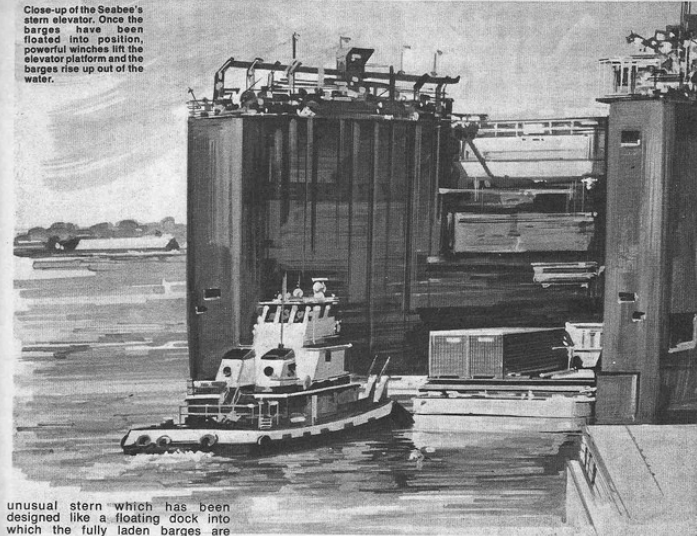
Where the 'mother' Seabee differs from any other ship ever built is in her

CONTINUED ON NEXT PAGE



Cutaway of the Seabee carrier which can be loaded in a little over 12 hours with a cargo of 20,000 tons. Barges are raised by the elevator at the stern and conveyed to their stowage positions.

Close-up of the Seabee's stern elevator. Once the barges have been floated into position, powerful winches lift the elevator platform and the barges rise up out of the water.

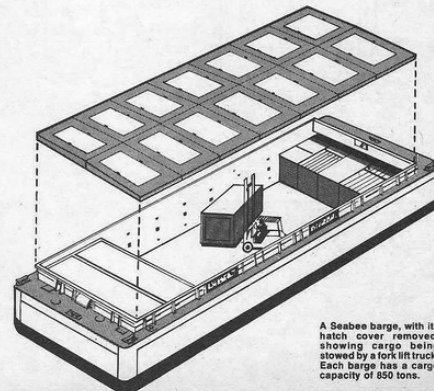


unusual stern which has been designed like a floating dock into which the fully laden barges are nudged by the tugs. The bottom of this stern 'dock' is actually a giant elevator platform suspended from six powerful hydraulic winches, and once the barges have been floated into position the winches lift the platform, and the barges slowly rise out of the water.

The elevator can be stopped level with one of the three vast decks which contain more than three-and-a-half miles (nearly 6 km.) of single-lane highway, and the barges are then ready to be moved into place for making the voyage. The elevator is capable of raising up to 2,000 tons at one go, at a speed of four feet (1.2 m.) a minute. Inside the hull of the Seabee, the cargo officer with his finger-tip control console summons up two huge multi-wheeled transporters which carry the barges to their final positions.

A typical full cargo of around 20,000 tons can be handled in a little over 12 hours by a few skilled seamen on the Seabees.

Once at sea, the Seabees' 36,000 hp steam turbines can power it along at speeds up to 20 knots (22.5 mph — or over 35 kmh.) enabling them to make the journey to Europe in about ten days. Then, within 24 hours they can be refuelled and reloaded ready for the return voyage.



A Seabee barge, with its hatch cover removed, showing cargo being stowed by a fork lift truck. Each barge has a cargo capacity of 850 tons.

THE CRUSADER

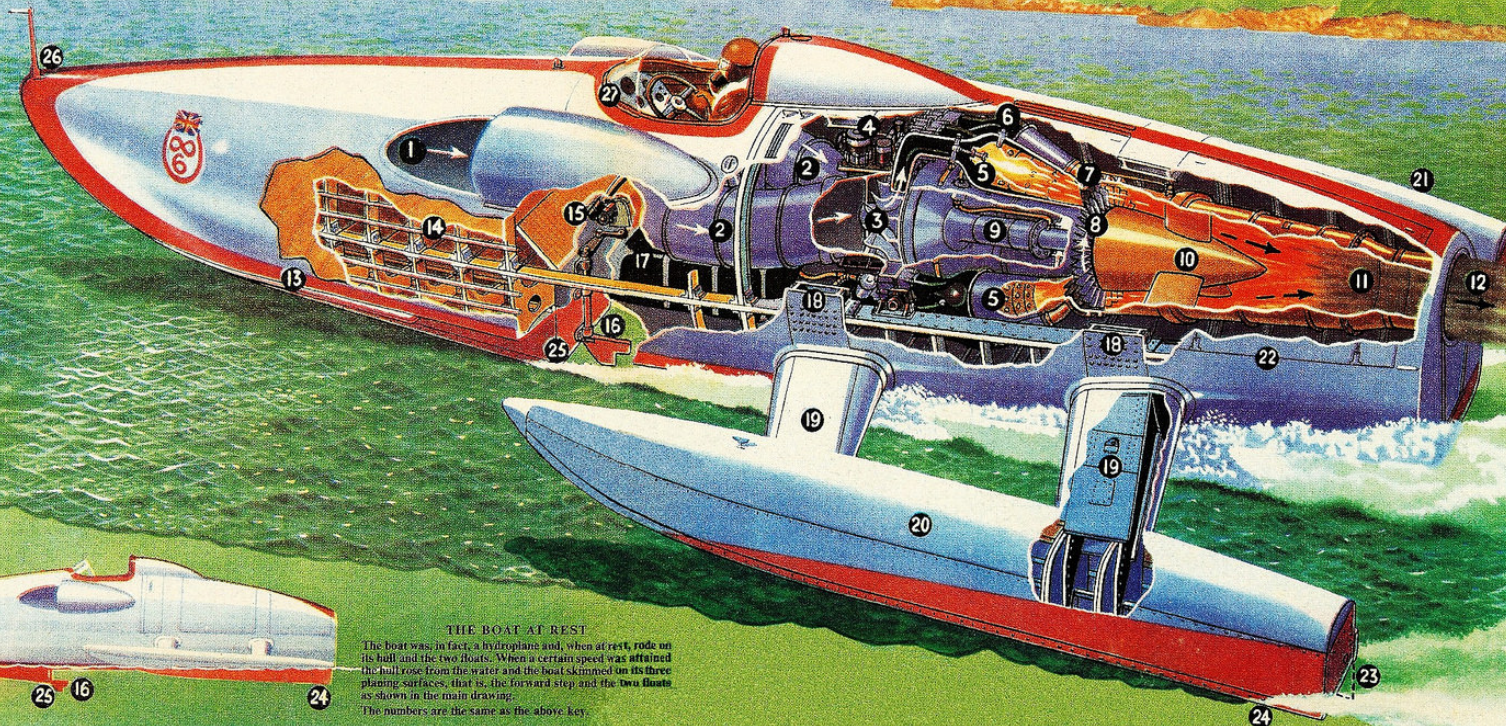
As a tribute to the late John Cobb, who lost his life at Loch Ness on the 29th September while attempting the world's water speed record (see this week's letter from the editor on p. 11.), we show here a sectional drawing of *The Crusader*, the jet speedboat in which John Cobb attained an unofficial world record of 206.89 m.p.h. The craft was 31 ft. long, with a span across the floats of 13 ft., and weighed, in running trim, 3 tons. It was powered by a De Havilland Ghost jet engine with a static thrust of 5,000 lbs. At 200 m.p.h. the engine would use 12 gallons of fuel a minute.

KEY TO ENGINE DETAILS

KEY TO OTHER PARTS

(1) Air intake scoops (port and starboard). (2-2) Air ducts to compressor. (3) Rotating compressor, which forces compressed air to the combustion chambers. (4) Electric starting motor and accessories. (5-5) Combustion chambers, with fuel nozzles, ten in all. Here the oil fuel mixes with the air and fired. (6) Sparking plug for starting up, after which combustion is spontaneous in every chamber. (7) Fixed blades directing the hot gases on to the turbine blades. (8) Turbine wheel, rotated at high speed by expanding hot gases. (9) Shaft from turbine wheel driving the compressor. (10) Cone, against which the jet thrust reacts. (11) Jet pipe. (12) Static jet thrust of 5,000 lbs.

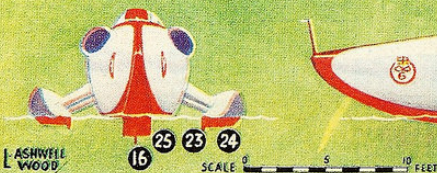
(13) Spray guard. (14) Frames and stringers of birch-ply, covered with birch-ply skin, the whole covered with highly polished doped fabric. (15) Steering gear and drop arm. (16) Rudder. (17) Oil fuel tank. (18-18) Fore and aft aluminium cantilever arms, connecting float. (20) Port float or sponson. (21) Starboard float. (22) Engine cowling. (23) Stabilising fins (port and starboard) for directional stability. (24) Port aft planing surface. (25) Forward planing surface and step. (26) Pitot head for air speed indicator. (27) Air speed indicator, providing the driver's only indication of speed.



THE BOAT AT REST

The boat was, in fact, a hydroplane and, when at rest, rode on its hull and the two floats. When a certain speed was attained the hull rose from the water and the boat skimmed on its three planing surfaces, that is, the forward step and the two floats as shown in the main drawing.

The numbers are the same as the above key.



THE MIGHTY SEA



At this time of the year we often hear of the tremendous seas met by some of our liners. The strain upon a ship in a rough sea is very great, and unless a vessel is designed on scientific lines, and very strongly constructed, it will "break its back". In this composite picture we try to show some of the conditions met with in rough weather.

KEY TO WAVE CONDITIONS

SHIP A. "Sagging". This condition exerts the greatest strain. A large liner resting on two huge waves, leaving the centre portion partially unsupported, tends to split the ship from the keel upwards. (1-2) Wave crests, 900 ft. apart, lifting the bow and stern. (3) The trough. This is the point of greatest strain. (4) Four expansion joints in top plating of superstructure. Some large liners are fitted with these joints, details of which are shown on the right. (5) Reinforced plating between main and promenade decks. (6) Reinforced plating of the usual double bottom. This is the "backbone" of the ship.

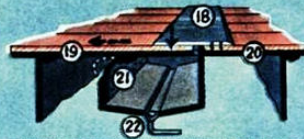
SHIP B. "Hogging". In this case a tremendous wave, coming amidships, leaves the bow and stern practically unsupported, tending to split the ship from the upper deck downwards. (7) Wave crest. (8) and (9). The trough.

SHIP C. "Rolling". The roll of a big ship is regular and constant. Details explained underneath.

SHIP D. "Pitching". A small ship will "ride" over very large waves with a great amount of pitch when she goes into the trough. **SHIP E.** The large ship pitches into a wave with regular pendulum-like motion.

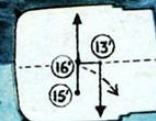
SHIP F. "Giving". When struck on the side by a heavy sea a ship "gives", that is, the vessel is pushed to one side. If this did not happen, the ship would be pounded to pieces as a ship on the rocks is pounded.

SHIP G. "Head sea". This causes enormous strain on the engines. (This is the same ship in three positions). (10) Ship proceeding normally at 25 knots. (11) Collision with head wave. Speed suddenly drops to 22 knots. (12) Engines now have to re-assort themselves back to normal speed.



Expansion joints in the superstructure of a big ship enable the light plating to escape the heavy stresses taken by the reinforced plating in a big sea. (18) Sliding plate over deck gap. (19) Moving plating. (20) Fixed plating. (21) Flexible steel. The joint is shown close up when the ship is "sagging". The dotted line and vertical arrow shows the position of joint opened up when the ship is "hogging". (22) Drain collecting any water from deck.

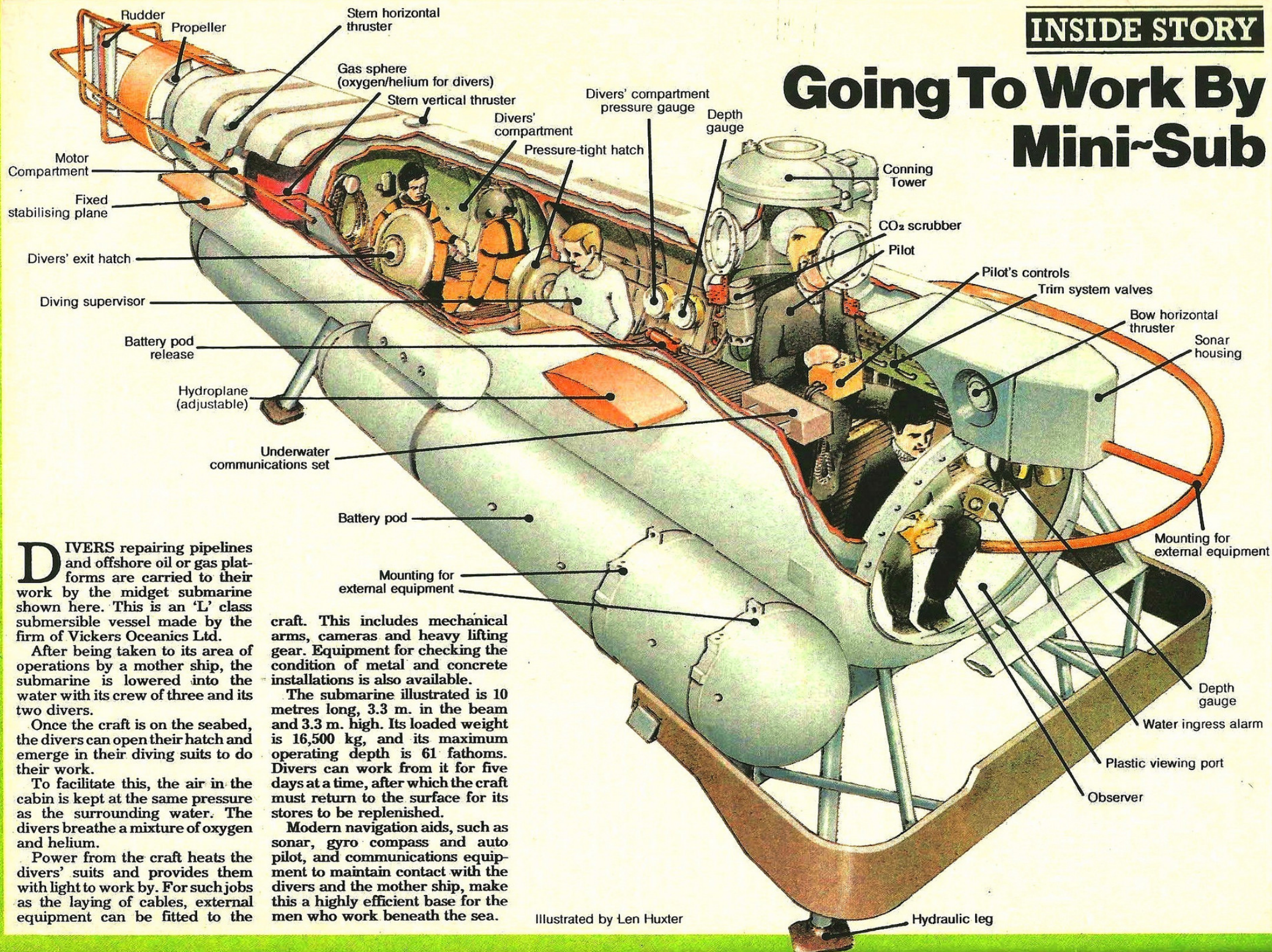
Waves are built up in layers underneath, and when these coincide at one point a big wave is formed. (23) Wind compressing the sea and forming trough. (24) Crest formed by compressed sea escaping upwards.



Rolling and stability or the power of a ship to right herself. (13) Centre of gravity pulling downwards. (14) Centre of buoyancy pulling upwards when ship is upright. (15) Centre of buoyancy has shifted when ship rolls. (16) Upward pull of buoyancy makes this arm or lever about centre of gravity. It is this lever and the powers acting upon it which enables the ship to return to the upright position. (17) Position of ship's metacentre. In the small diagram it will be seen that the downward pull of gravity 13' and the upward pull of buoyancy 15' have conspired to produce a lever 16' which will capsize the ship. This condition will come about by movement of cargo or water in the holds, as in the recent "Enterprise" epic. Can you name the ships shown above? See answers on page 11.

ASHWELL WOOD

Going To Work By Mini-Sub



DIVERS repairing pipelines and offshore oil or gas platforms are carried to their work by the midget submarine shown here. This is an 'L' class submersible vessel made by the firm of Vickers Oceanics Ltd.

After being taken to its area of operations by a mother ship, the submarine is lowered into the water with its crew of three and its two divers.

Once the craft is on the seabed, the divers can open their hatch and emerge in their diving suits to do their work.

To facilitate this, the air in the cabin is kept at the same pressure as the surrounding water. The divers breathe a mixture of oxygen and helium.

Power from the craft heats the divers' suits and provides them with light to work by. For such jobs as the laying of cables, external equipment can be fitted to the

craft. This includes mechanical arms, cameras and heavy lifting gear. Equipment for checking the condition of metal and concrete installations is also available.

The submarine illustrated is 10 metres long, 3.3 m. in the beam and 3.3 m. high. Its loaded weight is 16,500 kg, and its maximum operating depth is 61 fathoms. Divers can work from it for five days at a time, after which the craft must return to the surface for its stores to be replenished.

Modern navigation aids, such as sonar, gyro compass and auto pilot, and communications equipment to maintain contact with the divers and the mother ship, make this a highly efficient base for the men who work beneath the sea.

Illustrated by Len Huxter

WHAT'S NEW?

The U.S. ARMY'S HOVERTRUCK



THE unusual vehicle illustrated here could well be the forerunner for all future army and service lorries, no longer dependent on well made and surfaced roads to bring supplies up to the front, but fully capable of following either tanks or infantry over the roughest terrain. Developed in the United States by the Ford company, it is the very first Hovertruck built for military use and is currently under trial with the American Army. 21-ft. long and weighing some $3\frac{1}{2}$ tons, the Hovertruck is powered by coupled six-cylinder aircraft engines which give it a top speed of over 40 mph. The whole secret of the Hovertruck lies in the seven 21-in. diameter fans arranged along each side of the truck's body. Facing straight up under a metal

grille, these fans suck in enough air at full throttle to build up 50 lb. of pressure per square foot beneath the truck body. The stiff plastic skirting around the vehicle enables the driver to steer. This is achieved by means of movable louvres or vents along the sides and across the front and rear of the chassis which force the trapped air beneath the skirting in any required direction in order to propel, steer or brake the vehicle. Capable of carrying a one-ton cargo of either men, arms or supplies, the Hovertruck will clear the ground, water or ice by two or three feet. Without doubt it will be a very useful addition to any modern army which needs to travel fast over any sort of country.

THE sight and sound of a steam locomotive at full speed, steam billowing from its chimney as its wheels pound the tracks, is one which has been denied to many people in Britain for over ten years. Steam locomotives are now used only on special occasions: their place has been taken by the all-conquering diesel and electric locos, more efficient yet infinitely less romantic and alluring.

Weighing hundreds of tons, the locomotives would be run by two men, the driver, who was in charge, and the fireman, who stoked the firebox. The coal and water were stored in the tender.

On the locomotive we have illustrated, which was used for fast long-distance passenger work between London and the North, more space could be given over to coal since the lines it ran on were

INSIDE STORY

Air, Fire And Water..

These three elements, in the right combination, provided the power for the steam locomotives which once dominated Britain's railway system

equipped with track-troughs. These enabled the tender to scoop up water as it thundered along.

Feeding the coal to the firebox was hot and hard work, for it all had to be done with a shovel. The fireman would have to place the coal very carefully in the firebox, or it would not burn up properly.

The flames had to be very high, for they were drawn right the way through the boiler in long flues, known as fire tubes. A brick arch prevented flames and cinders being drawn through the tubes until they were fully hot.

Full of flames, the fire tubes heated up the water in the boiler, building up a great pressure of steam. A superheater made the steam hot and dry, and it was then allowed to pass through a regulator valve into the main steam pipe, on its way to the pistons.

Clack valves at the top of the boiler fed water in to replace that which had boiled into steam. They were specially designed to inject the water against the enormous pressure in the boiler.

Passing through the regulator valve, the steam would shoot down

the main steam pipe to the piston valves. These passed the steam alternately to one side and the other of a piston in the cylinder, moving it to and fro.

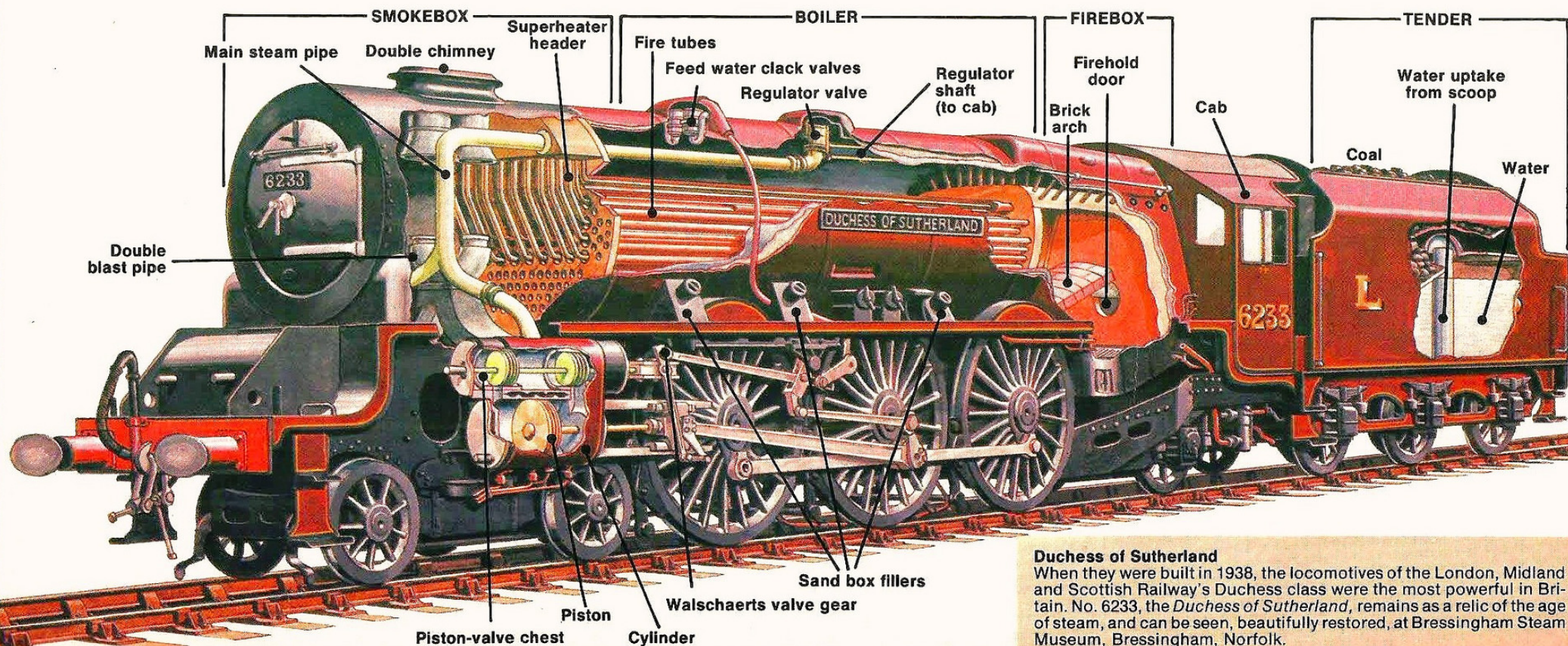
At this point, you could begin to see from the outside what was happening, although all that could be understood at first sight was the rotation of the wheels. The rest seemed to be merely a fast-moving *mêlée* of rods and axles.

But all this pushing and whirling was very definitely controlled by a valve gear, named after its Belgian inventor, Walschaerts. This regu-

lated the passing of steam to the front and back of the pistons and kept the complicated machinery turning smoothly.

When the steam left the cylinders it rushed up through the blast pipe and then escaped to the outside through the chimney. In so doing, it created an enormous draught, and it was this draught which drew the flames from the firebox through the fire tubes.

The driver controlled the draught by regulating a grate underneath the firebox. If he saw sparks coming out of the chimney, he knew he was doing a bad job of it, for it was a waste of fuel if flames were entering the smokebox. Ideally, only smoke and spent ashes ought to have escaped into the smokebox. The escaping steam drew them out through the chimney in big puffs, corresponding to the movement of the pistons.



Duchess of Sutherland

When they were built in 1938, the locomotives of the London, Midland and Scottish Railway's Duchess class were the most powerful in Britain. No. 6233, the *Duchess of Sutherland*, remains as a relic of the age of steam, and can be seen, beautifully restored, at Bressingham Steam Museum, Bressingham, Norfolk.

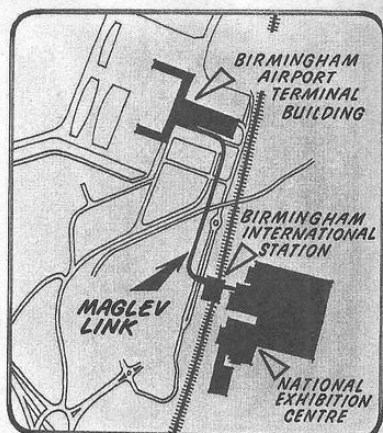
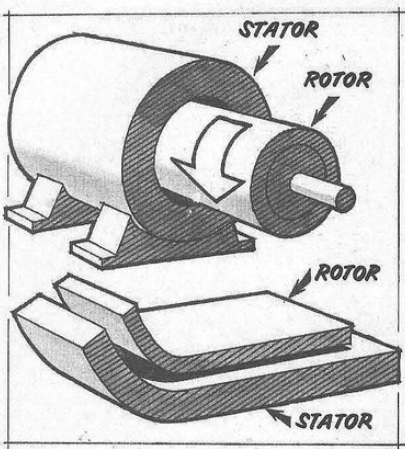
HARDY'S DRAWING BOARD

The Magic Of Maglev

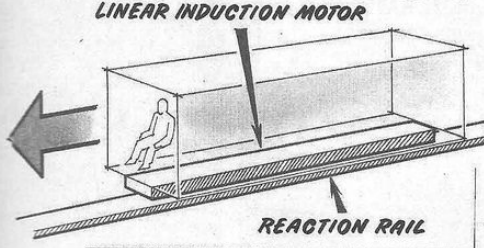
Engineers at British Rail Research have come up with a rail vehicle that has a very unusual propulsion system



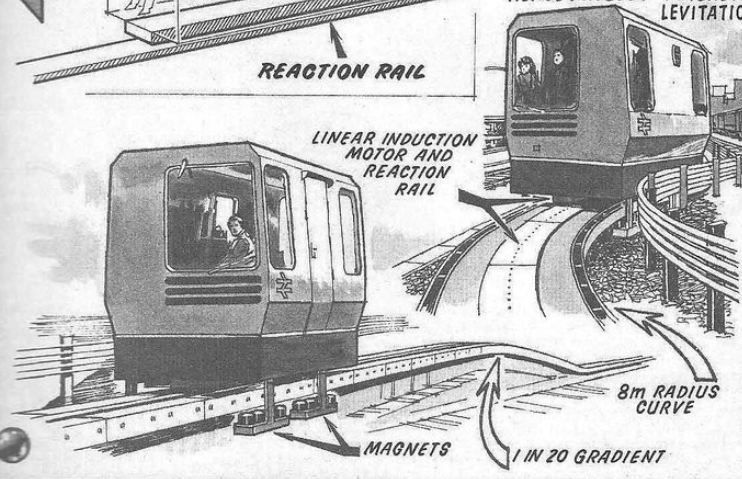
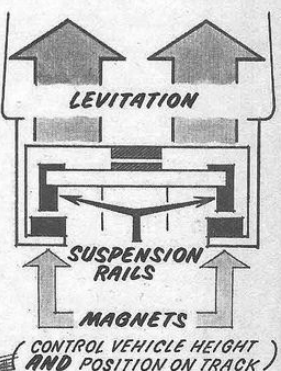
FROM THE MID-1980'S YOU WILL HAVE THE CHANCE TO RIDE ON A HISTORIC RAIL LINK—THE WORLD'S FIRST COMMERCIAL MAGLEV LINE. IT WILL RUN FROM THE NEW TERMINAL AT BIRMINGHAM AIRPORT TO THE NATIONAL EXHIBITION CENTRE. THE SYSTEM HAS NO WHEELS AND NO ENGINE WITH MOVING PARTS! SO HOW DOES IT WORK? A SIMPLE ELECTRIC MOTOR HAS A STATIC SECTION (STATOR) AND A ROTATING ONE (ROTOR). WHEN ELECTRICITY IS FLOWING, THE MAGNETIC FORCE BETWEEN THE TWO SECTIONS CAUSES THE ROTOR TO SPIN. WE CAN NOW FLATTEN OUT THE SECTIONS AND MOUNT THE STATOR AS A SERIES OF METALLIC WINDINGS...



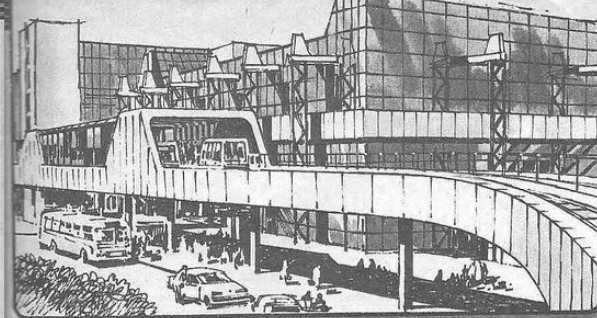
...UNDER A RAIL VEHICLE AND FIX THE ROTOR AS A CONTINUOUS ALUMINIUM/STEEL RAIL ON A TRACK. WHEN WE APPLY POWER THE MAGNETIC FORCES WILL PROPEL THE VEHICLE FORWARD OR STOP IT AS REQUIRED. THE TWO UNITS, PROPERLY NAMED, ARE SHOWN BELOW.



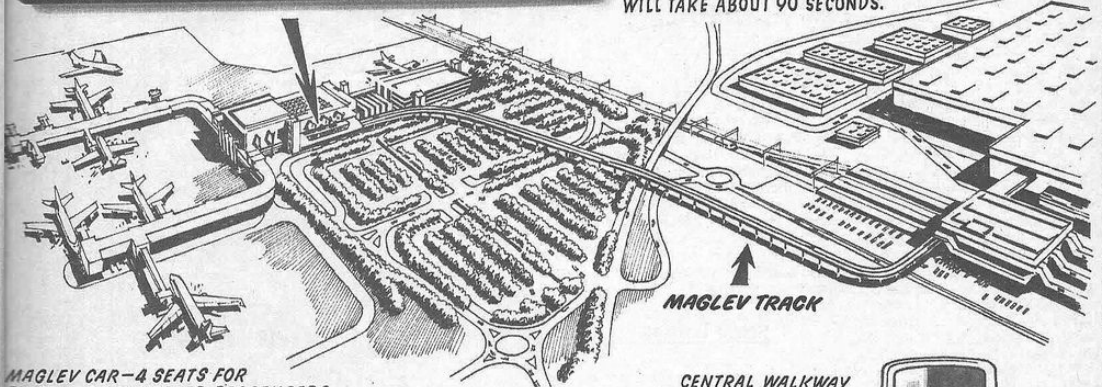
TO RAISE THE VEHICLE OFF THE GROUND WE USE MORE MAGNETIC FORCE. POWERFUL MAGNETS ARE PLACED AT EACH CORNER BELOW THE VEHICLE. ABOVE THEM ON THE TRACK HOLDING THE REACTION RAIL ARE PLACED TWO STEEL SUSPENSION RAILS. WHEN THE MAGNETS ARE SWITCHED ON THEY ATTRACT THE METAL RAILS AND RAISE THE VEHICLE—HENCE MAGLEV—MAGNETIC LEVITATION!



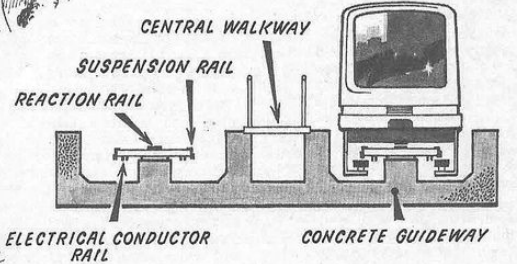
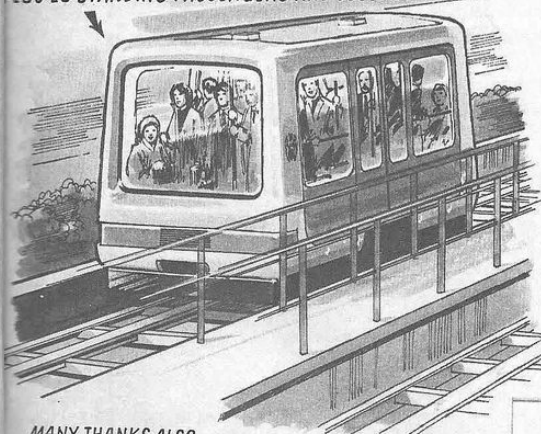
BRITISH RAIL'S RESEARCH CENTRE AT DERBY BEGAN ITS STUDIES OF MAGNETIC SUSPENSION IN 1973 AND IN 1974 BUILT THE EXPERIMENTAL VEHICLE SHOWN HERE. THE VEHICLE HAS PROVED THE POTENTIAL OF THIS PROPULSION AND SUSPENSION SYSTEM TO OPERATE EASILY AROUND TIGHT CURVES AND TO CLIMB STEEP SLOPES WHILE HEAVILY LOADED. THE MAGLEV RESEARCH VEHICLE IS 3.5m LONG AND WEIGHS ALMOST 3 TONNES. WHEN IT IS "FLYING" THE AIR GAP BENEATH IT IS 15mm (1/2") THE TEST TRACK ITSELF IS 100m LONG.



THE MAGLEV TRACK AT BIRMINGHAM AIRPORT WILL BE 600m LONG. THE STATION AT THE AIRPORT END IS SHOWN IN THE IMPRESSION (LEFT) AND THE ILLUSTRATION BELOW SHOWS THE WHOLE LAYOUT FROM AIRPORT TO NATIONAL EXHIBITION CENTRE. THE MAGLEV CARS, EACH HOLDING UP TO 32 PASSENGERS AND THEIR LUGGAGE WILL OPERATE AUTOMATICALLY ON A CONTINUOUS SHUTTLE SYSTEM. THE LONGEST WAIT FOR A CAR WILL BE ABOUT TWO MINUTES AND THE JOURNEY ITSELF WILL TAKE ABOUT 90 SECONDS.



MAGLEV CAR—A SEAT FOR ELDERLY OR DISABLED PASSENGERS PLUS 28 STANDING PASSENGERS AND LUGGAGE



A CONTROLLER WILL SUPERVISE OPERATIONS AT ALL TIMES BUT THE CARS AND THEIR OPERATION ON THE TWIN (UNCONNECTED) TRACKS WILL BE COMPLETELY AUTOMATIC. THE MAGLEV CAR IS KEPT ACCURATELY ON THE TRACK BY OFFSETTING THE POWERFUL MAGNETS SLIGHTLY AND THEN VARYING THE POWER TO EACH SET TO KEEP IT PROPERLY POSITIONED. SMALL RETRACTABLE WHEELS ARE FITTED FOR TOWING A CAR SHOULD IT BE NECESSARY.

MANY THANKS ALSO TO BRITISH RAIL'S RESEARCH & DEVELOPMENT DIVISION



PMG—PEOPLE MOVER GROUP—IS A CONSORTIUM OF COMPANIES ALL BRINGING THEIR SPECIAL SKILLS TO THE PROJECT. THEY SUPPLIED THE AIRPORT INFORMATION—THANK YOU!



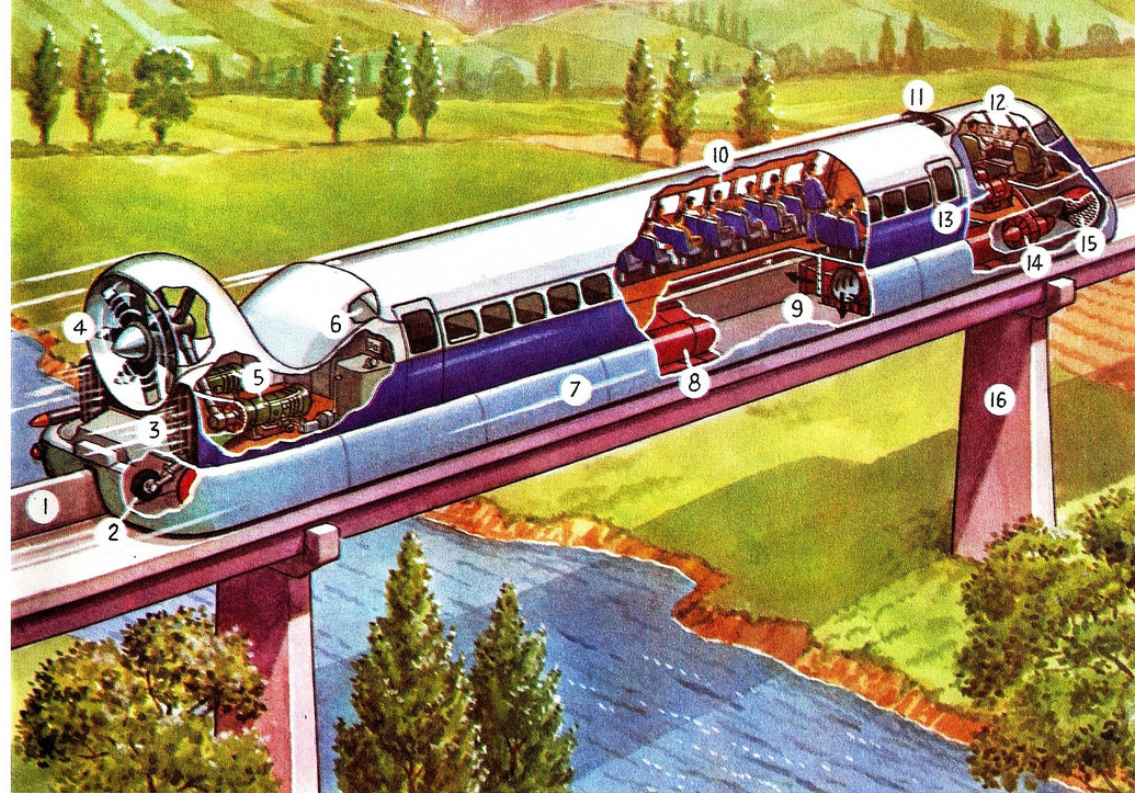
Magnetic Suspension Studies by British Rail

BIRMINGHAM AIRPORT MAGLEV

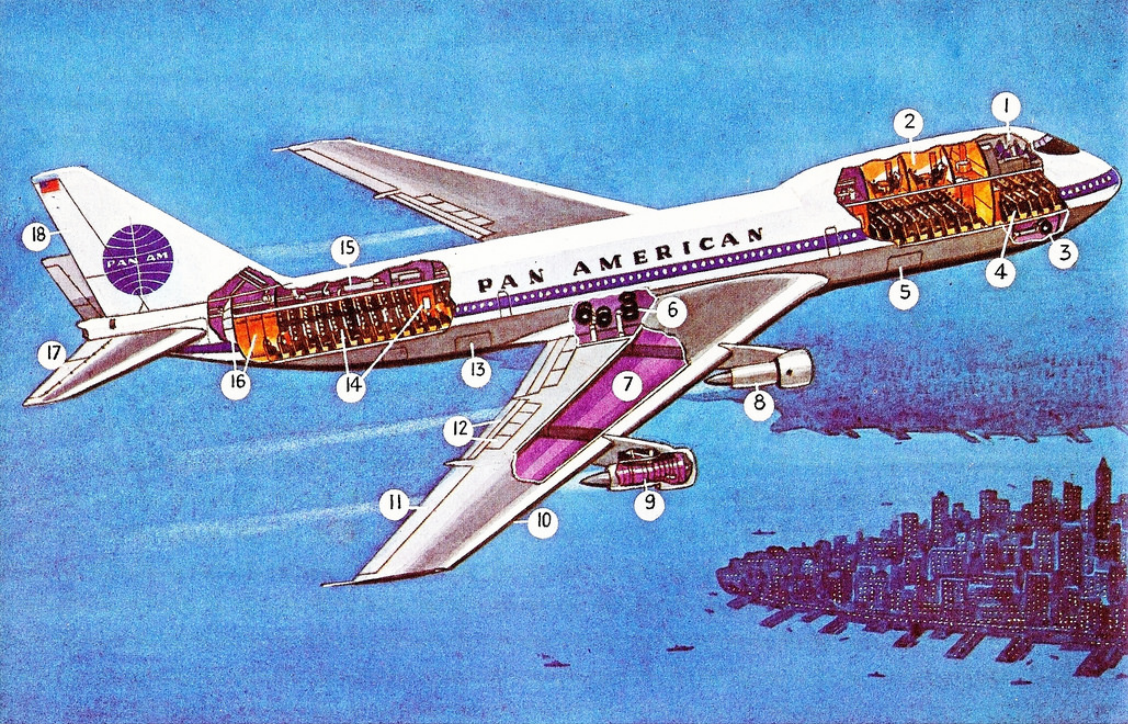
A TRAIN WITHOUT WHEELS

A 160-m.p.h. Hovertrain is the latest idea in air-cushion vehicles. An 80-seater vehicle is to run the 70 miles between Paris and Orleans, France. It is propelled from the rear by two 1,500-h.p. gas-turbine engines driving a reverse-bladed propeller. In front a 400-h.p. gas-turbine engine drives two axial-flow fans, one each side, which supply high-pressure air for the air cushion lift and the air cushion against both sides of the central guidance rail. The train glides on an elevated concrete track on a half-inch cushion of air. In places, the track is 16 ft. above the ground to clear existing roads and rivers. The 80-seater passenger cabin is air-conditioned and soundproof. The vehicle is 84 ft. long and weighs 20 tons loaded.

KEY TO NUMBERED PARTS
(1) Central guidance rail. (2) Retractable wheels, each end, can be lowered when the vehicle is at rest at stations, etc. (3) Engine exhaust ducts. (4) Seven-bladed propulsion propeller. (5) Two 1,500-h.p. Turbo gas-turbine engines driving propeller. (6) Air inlet to engines. (7) Aluminium sheet side-walls. (8) Tubular air-cushion skirt runs whole length of train – both sides. (9) High-pressure cushion air provides lift from the track and a cushion both sides of central guidance rail. (10) Air-conditioned passenger cabin. (11) Engine exhaust duct. (12) Driver's cab. (13) Turbomeca 400-h.p. gas-turbine engine driving two fans. (14) Axial-flow air-cushion fans. (15) Air inlet to fans. (16) Elevated concrete track.



HOVERTRAIN

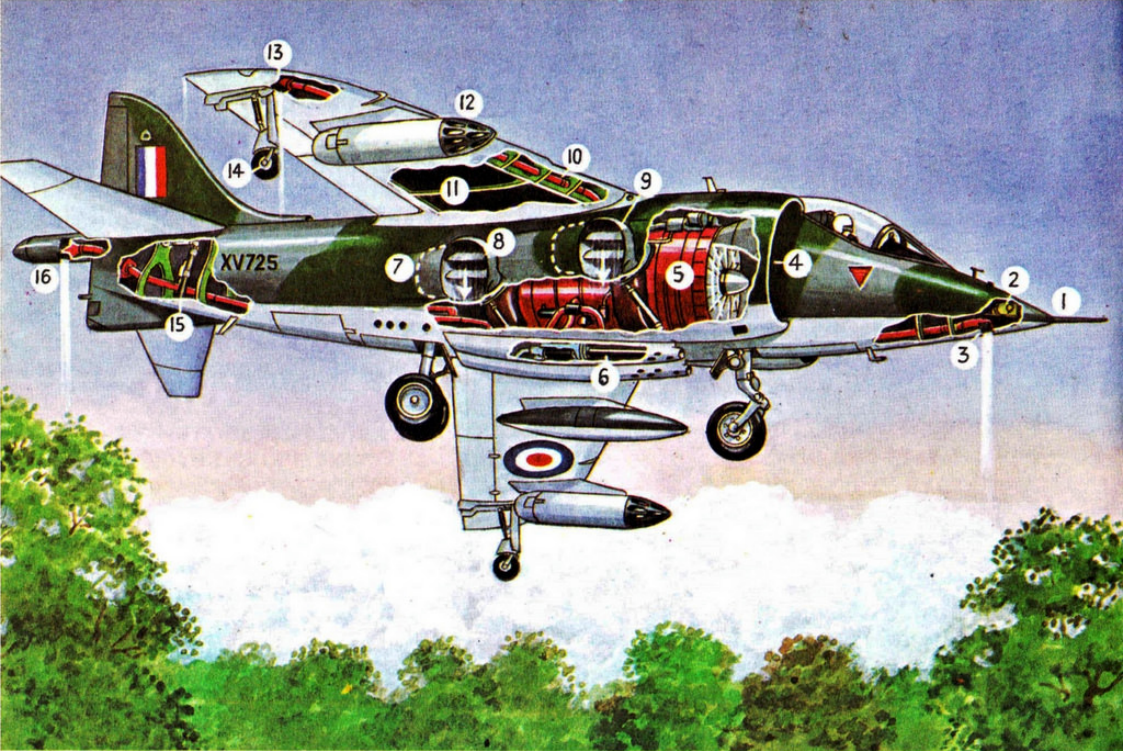


BOEING 747
PAN AMERICAN AIRLINES

WORLD'S LARGEST JUMBO JET

KEY TO NUMBERED PARTS
 (1) Flight deck for Captain, Co-pilot, Flight engineer, Navigator and Radio operator. (2) Passenger lounge and staterooms. (4) Forward passenger cabin. (5) Loading doors for special cargo containers. (6) Four bogie wheels abreast main undercarriage, retracted. (7) Wing fuel tanks. (8) Inner starboard Pratt and Whitney by-pass turbofan jet engine. (9) Outer starboard engine. (10) Leading edge flaps used for landing. (11) Ailerons. (12) Double slotted flaps used for take-off and landing. (13) Rear cargo doors. (14) Ten abreast passenger seating and food galley. (15) Flying control runs. (16) End of pressurised passenger compartment. (17) Pivoted tail plane and elevators. (18) Rudder and fin.

AMERICA'S Jumbo jet, the Boeing 747 is the world's largest commercial air-liner, shown on opposite page over New York Harbour. These monsters have a loaded take-off weight of 340 tons and can carry 490 passengers seated 10 abreast. A special feature is the huge main passenger cabin 19 ft. 7 in. wide, stretching from nose to tail. There is a second deck at the forward end for flight crew, passenger lounge and staterooms. Built at a cost of £8 million each these gigantic aircraft are powered by four by-pass turbofan jet engines of 41,000 pounds thrust each, mounted in pods below the wings, giving the aircraft a cruising speed of over 600 miles an hour with a range of 5,900 miles. Length 231 ft. Wing span 195 ft. Top of fin is 62 ft. 7 ins. above ground level.



HARRIER
ROYAL AIR FORCE

STRAIGHT UP—AND ALONG

KEY TO NUMBERED PARTS

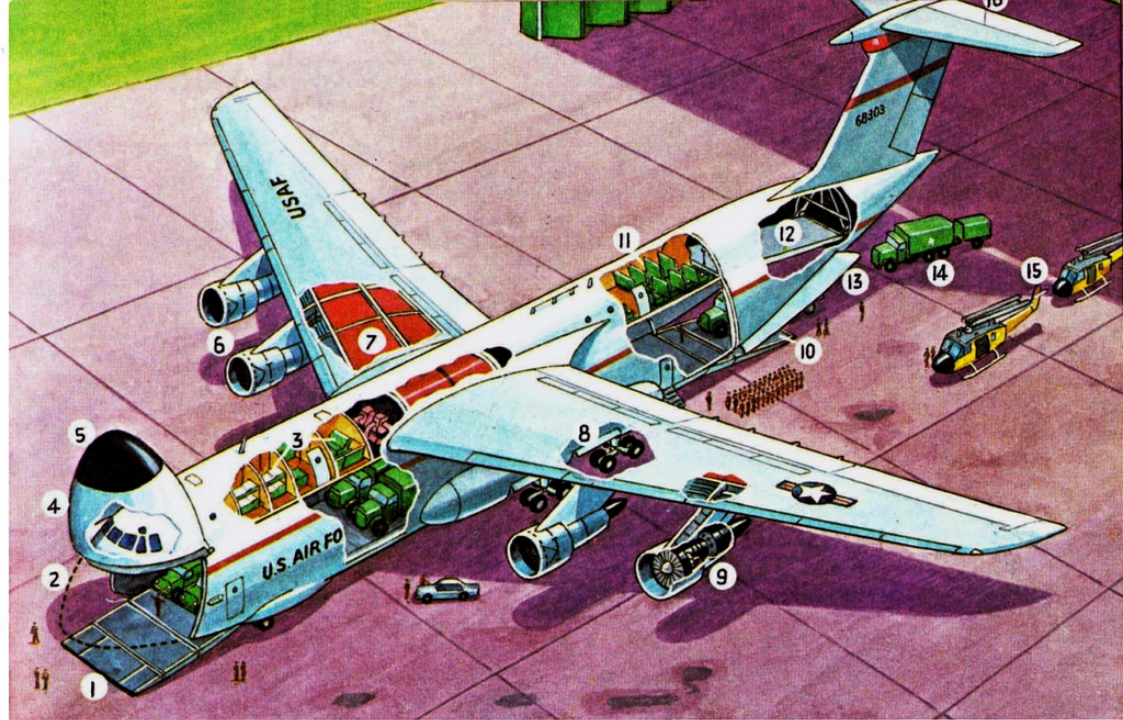
(1) Probe for air speed indication. (2) Camera. (3) Nose pitch, air control. (4) Air intake to engine, both sides. (5) Bristol Pegasus 6 jet engine. (6) Two 30 mm. Aden guns. (7) Position of nozzle for forward flight. (8) Hot gas thrust nozzle rotated downwards for vertical flight. (9) Compressed air thrust nozzle rotated downwards. (10) Compressed air pipe to wing tip. (11) Fuel tanks in wings. (12) Rocket weapon launchers. (13) Wing tip roll, air control. (14) Wing tip landing wheels, these are retracted into the wing in forward flight. (15) Tilting tail plane operating jack. (16) Tail pitch, air control. By operating these air controls the pilot can keep the aircraft level during take-off.

THE Hawker Siddeley Harrier is the world's first V/STOL (Vertical or Short Take-off and Landing) strike aircraft. It can take-off vertically from any small patch of ground, even if surrounded by trees. It can climb rapidly to 40,000 feet and proceed forwards in horizontal flight at 1,000 miles an hour. Range 2,000 miles. The single Bristol Pegasus 6 jet engine has four rotating nozzles, two each side. The thrust from these can be rotated downwards for vertical lift—rearwards for forward flight and forwards for braking and hovering, no other aircraft can do this. Compressed air from the engine is piped to the nose, tail, wing tips for pitch and roll control. A great variety of weapons can be carried under the wings. Length 46 ft. 4 ins. Drooped wing span 25 ft. 3 ins.

BIGGEST PLANE EVER BUILT

SO huge is this super-transport, shown opposite, that its controls have to be operated by computers. Its tail is as high as a six-storey building. This is the Lockheed C-5A Galaxy of America. With a loaded weight of 350 tons it is hard to conceive how it gets off the ground. The power is provided by four giant General Electric CTF turbofan engines, suspended in pods beneath the wings. The huge interior can accommodate tanks, helicopters, trucks and 75 troops, or it can be converted to carry 840 troops to any trouble spot in the world. The Galaxy cruises at 541 miles an hour and has the terrific range of 6,300 miles. Length 222 ft. 8 ins. Wing span 245 ft. 11 ins. The tail plane is 64 feet above the ground. The R.A.F. might use these aircraft.

KEY TO NUMBERED PARTS
(1) Folding loading ramp lowered. (2) Position of nose when lowered. (3) Upper deck for flight crew, crew rest rooms and important person's lounge. (4) Nose cargo door raised. (5) Radar dome. (6) Starboard turbofan engines. (7) Wing fuel tanks, total tank capacity 42,000 gallons. (8) Main retractable under-carriage of 24 wheels 12 each side. (9) General Electric CTF turbofan engines, each of 41,000 pounds thrust. The intake fan is 8 feet in diameter. (10) Rear cargo ramp lowered. (11) Accommodation for 75 troops on rear upper deck. (12) Upward opening cargo door. (13) Fuselage petal doors open. (14) U.S. Army trucks being loaded. (15) Two 3½ ton Bell helicopters can be carried.



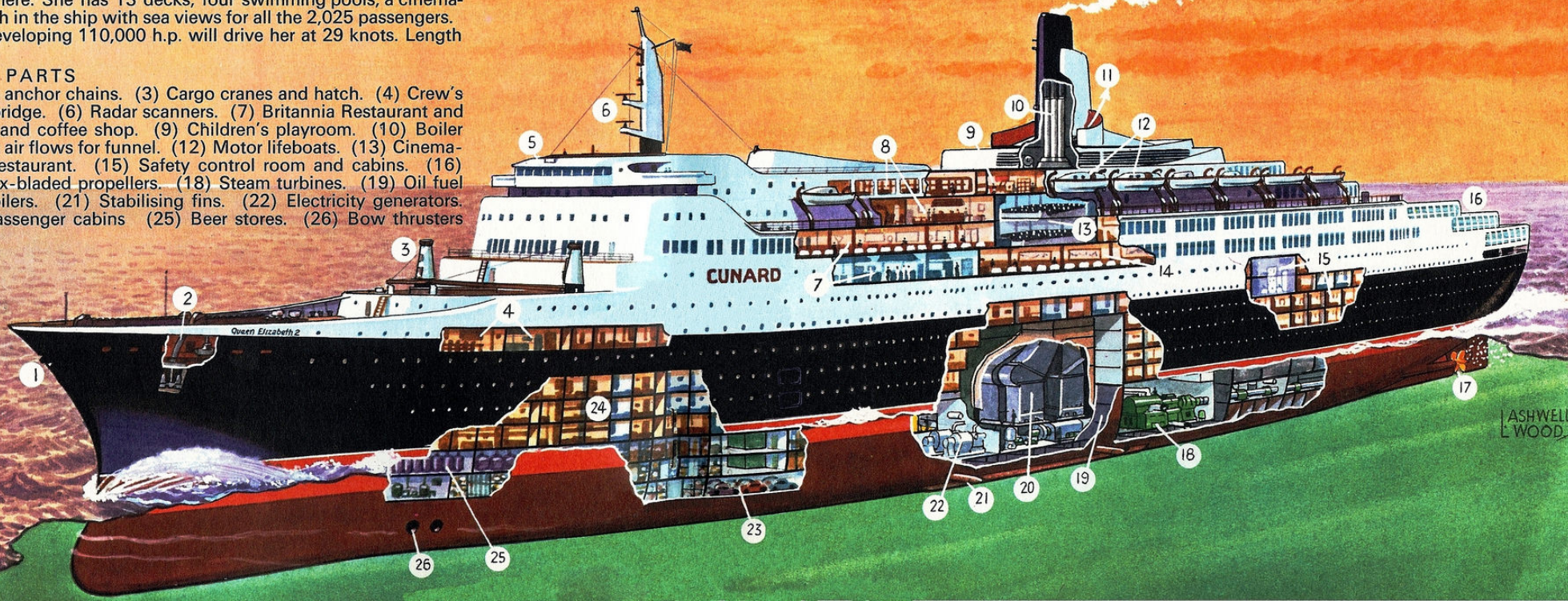
LOCKHEED GALAXY
UNITED STATES AIR FORCE

QUEEN ELIZABETH 2 WORLD'S FINEST SHIP

TODAY'S most modern passenger ship the 65,000 ton Cunard QE2 is a floating hotel built to go anywhere. She has 13 decks, four swimming pools, a cinema-theatre and restaurants high in the ship with sea views for all the 2,025 passengers. Her two steam turbines developing 110,000 h.p. will drive her at 29 knots. Length 963 feet.

KEY TO NUMBERED PARTS

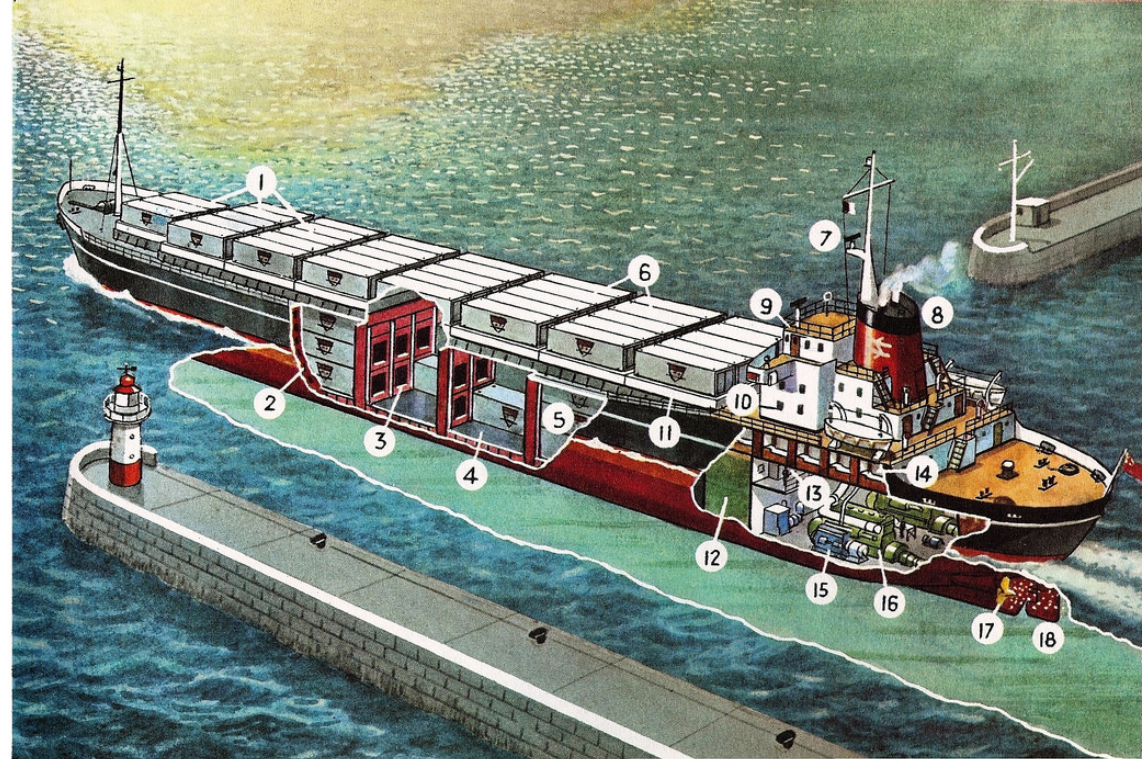
(1) Bow anchor. (2) Side anchor chains. (3) Cargo cranes and hatch. (4) Crew's quarters. (5) Navigation bridge. (6) Radar scanners. (7) Britannia Restaurant and kitchens. (8) Sports lido and coffee shop. (9) Children's playroom. (10) Boiler exhaust pipe. (11) Curved air flows for funnel. (12) Motor lifeboats. (13) Cinema-theatre. (14) Columbia restaurant. (15) Safety control room and cabins. (16) Swimming pools. (17) Six-bladed propellers. (18) Steam turbines. (19) Oil fuel tanks. (20) New type boilers. (21) Stabilising fins. (22) Electricity generators. (23) Car garage. (24) Passenger cabins. (25) Beer stores. (26) Bow thrusters for easy docking.



NEW METHODS OF SEA TRANSPORT

THE container ship is an entirely new method of cargo carrying and ships of all sizes are being specially built for this purpose. The containers are steel "boxes" 20, 30 or 40 feet long, they can be packed with goods at a factory and sealed, then transported by road or rail directly to the container ship. Here the 20 ton containers are loaded into the container ship by special transporter cranes. Loading or unloading takes only 1½ minutes. At the other end the containers are delivered direct to the customer—still sealed. The 4,500 ton container ship, SeaFreighter 1 operates between Harwich and Zeebrugge, Belgium. It has a capacity for 148 containers, 110 of them are in 8 holds and 38 stowed on the hatch covers of the holds. Length of ship 388 ft. 6 ins. Speed 13½ knots.

KEY TO NUMBERED PARTS
(1) Containers fixed to hatch covers on deck. (2) Double side and bottom hull construction. (3) Container guide rails and bulkheads for 8 holds. (4) Containers removed to show construction. (5) Containers stowed three deep. (6) Containers fixed to hatch covers. (7) Radar scanner. (8) Streamlined funnel and mast. (9) Navigation bridge. (10) Officers' cabins. All the accommodation, engines and machinery are placed aft. (11) Hatch covers are opened and closed by hydraulic jacks. (12) Oil fuel tanks. (13) Engine control panel. (14) Crew quarters. (15) Diesel generators for electrical supplies. (16) Main twin diesel engines driving propellers. (17) Port propeller. (18) Rudder.



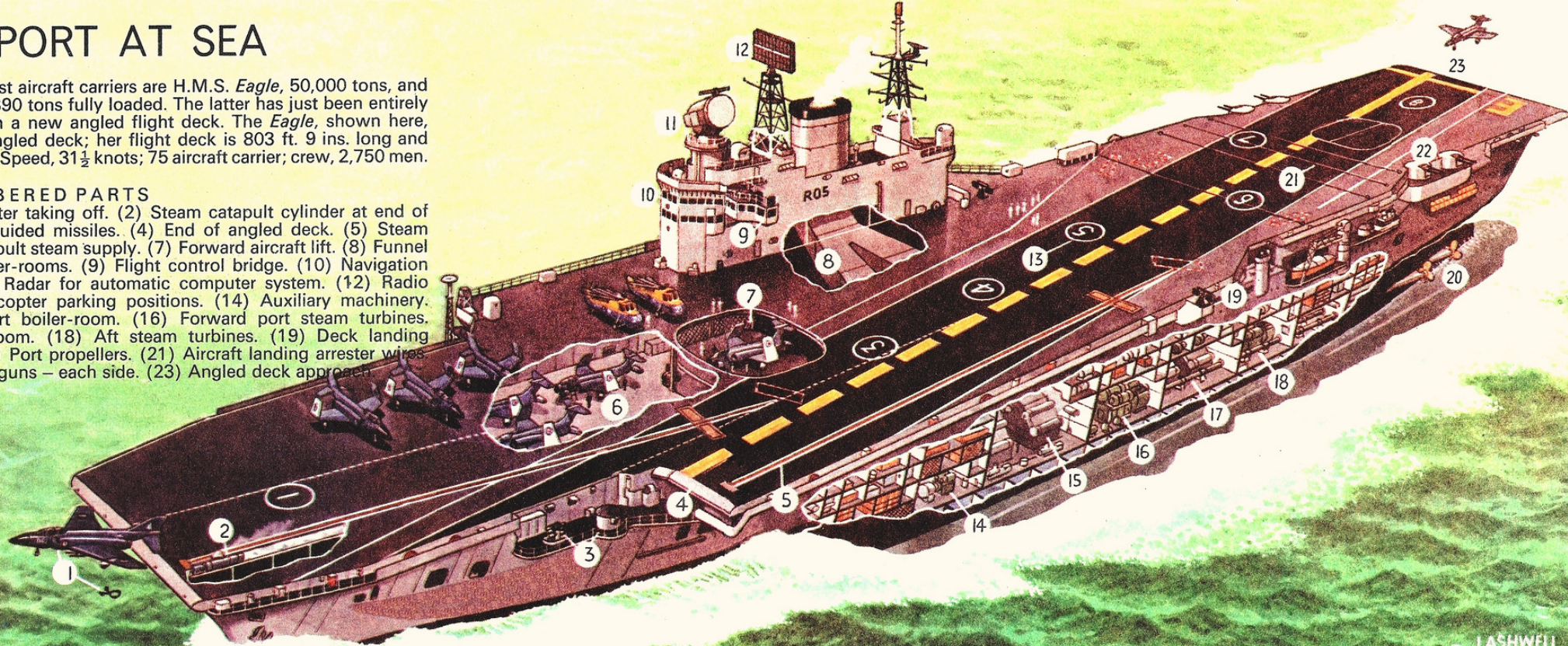
SEA FREIGHTER 1
BRITISH RAIL CONTAINER SERVICE

AN AIRPORT AT SEA

BRITAIN'S largest aircraft carriers are H.M.S. *Eagle*, 50,000 tons, and *Ark Royal*, 50,390 tons fully loaded. The latter has just been entirely reconstructed with a new angled flight deck. The *Eagle*, shown here, already has the angled deck; her flight deck is 803 ft. 9 ins. long and 112 ft. 9 ins. wide. Speed, 31½ knots; 75 aircraft carrier; crew, 2,750 men.

KEY TO NUMBERED PARTS

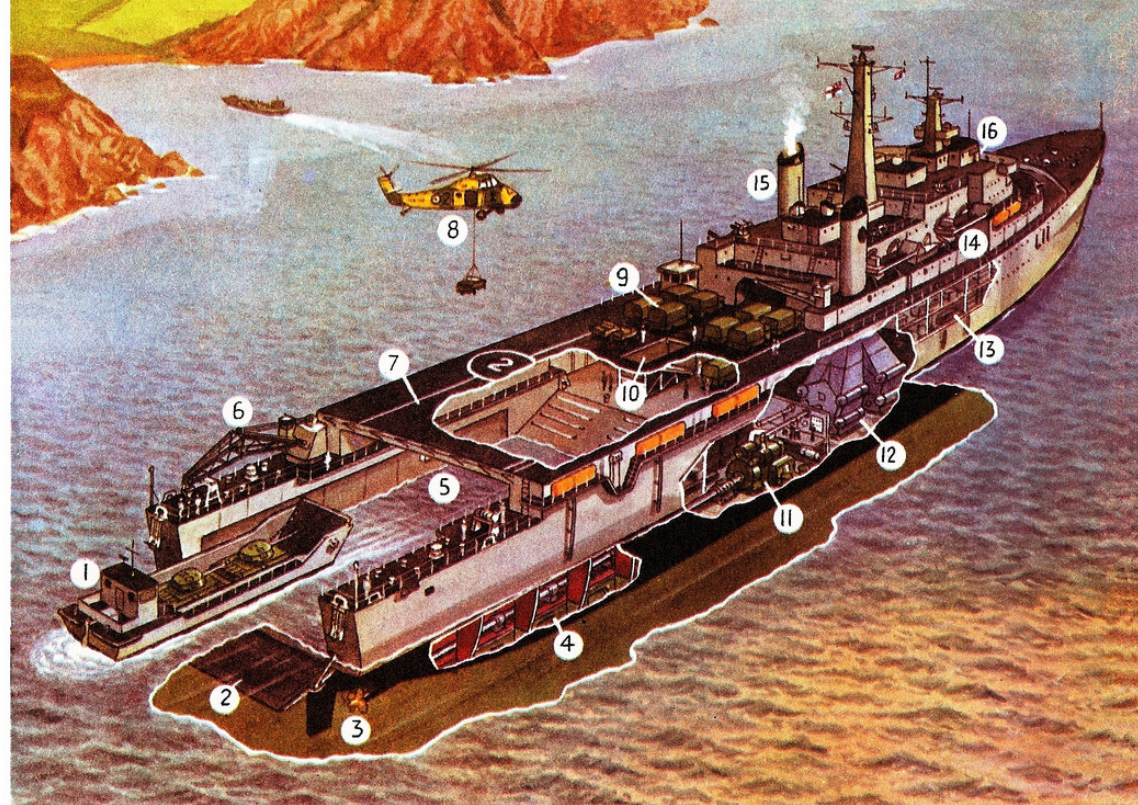
(1) Phantom fighter taking off. (2) Steam catapult cylinder at end of run. (3) Seacat guided missiles. (4) End of angled deck. (5) Steam catapult. (6) Catapult steam supply. (7) Forward aircraft lift. (8) Funnel uptakes from boiler-rooms. (9) Flight control bridge. (10) Navigation bridge. (11) 3-D Radar for automatic computer system. (12) Radio aerials. (13) Helicopter parking positions. (14) Auxiliary machinery. (15) Forward port boiler-room. (16) Forward port steam turbines. (17) Aft boiler-room. (18) Aft steam turbines. (19) Deck landing mirror sights. (20) Port propellers. (21) Aircraft landing arrester wires. (22) Four 4.5-in. guns – each side. (23) Angled deck approach.



FLOAT OFF - FLOAT ON SHIP

H.M.S. *Intrepid* is the second assault ship completed for the Royal Navy and sister ship of H.M.S. *Fearless*. The *Intrepid* can carry to anywhere in the world a complete military force of troops, tanks, scout cars, lorries and trucks. The troops can be put ashore by landing-craft carried in the ship's davits. The other landing-craft are carried in a dock at the stern, which can be flooded to enable tank landing-craft to 'float off -float on' under their own power. When the landing-craft return, the dock is pumped out dry, the stern door closed and the ship proceeds on her voyage. She is armed with Seacat guided missiles. Up to four Wessex helicopters are carried. The 12,100-ton ship has a speed of 23 knots. Length, 525 ft.; width, 80 ft. A fully equipped Royal Marine Commando or 700 Army troops can be carried.

KEY TO NUMBERED PARTS
(1) 176-ton landing-craft, with tanks, reversing out of the flooded dock. (2) Dock, stern lowered. (3) Starboard propeller and rudder. (4) Ballast tanks flooded to lower ship's stern. (5) Water level in flooded dock. (6) Dock crane. (7) Helicopter flight deck. (8) Wessex Commando helicopter off-loading a truck. (9) Deck stowage for lorries and trucks. (10) Hinged ramp for tanks and lorries to lower docking deck. (11) Starboard steam turbines - 12,000 h.p. (12) Starboard boilers and funnel uptakes. (13) Assault troop's quarters, dining halls and equipment. (14) Four 14-ton assault-troop landing-craft on swing-out davits - two each side. (15) The funnels are offset, the port funnel being more forward. (16) Navigation bridge and officers' quarters.

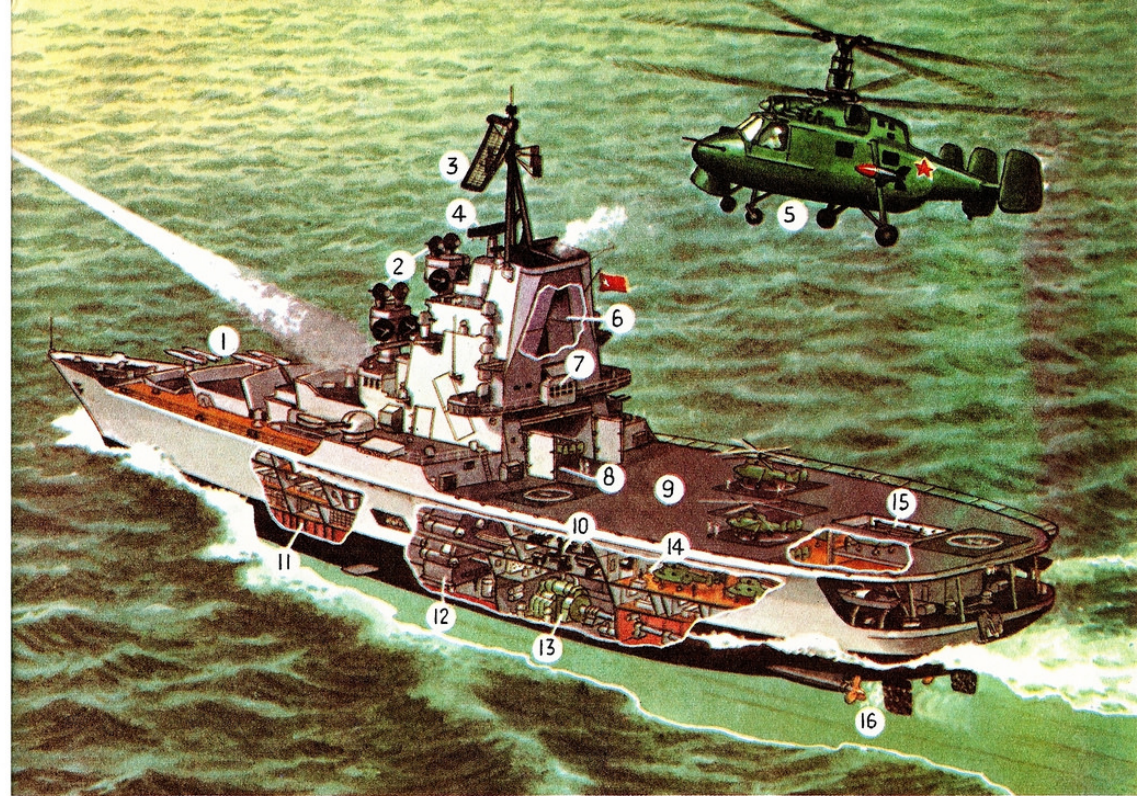


ASSAULT SHIP

SPECIAL HELICOPTER CARRIER

SOME of the secrets of the new Russian helicopter carrier *Moskva* are revealed in this drawing, together with one of the new Kamov 25 naval helicopters. This unusual looking ship has a massive structure amidships for the fire control towers, radar and funnel uptakes. The *Moskva* belongs to the Moscow Class, with her sister ship *Leningrad*. She is virtually a 15,000-ton floating helicopter platform; the flight deck is 295 ft. long, the ship itself being 645 ft. long. Up to 30 anti-submarine helicopters are carried. Her steam turbines give a speed of 30 knots. Forward of the amidship's structure is three sets of twin sea-to-air guided missile launchers. Amidships on either beam are twin 57-mm. guns. In between the funnel uptakes is a hanger with doors.

KEY TO NUMBERED PARTS
(1) Sea-to-air guided missile launchers – one set being fired. (2) Missile and gunfire control towers. (3) Revolving search and find radar. (4) Navigation radar scanner. (5) Kamov 25 anti-submarine strike helicopter, with two sets of rotating blades – speed 130 knots, search radar in nose. (6) Boiler-room split funnel uptakes. (7) Flying-control room. (8) Hangar – doors open, for quick getaway helicopter. (9) Flight deck, 295 ft long. (10) Workshops and helicopter servicing area. (11) Oil fuel tanks. (12) Boiler-rooms. (13) Steam turbine room – the turbines drive two propeller shafts. (14) Helicopter hangars can accommodate up to 30 helicopters with blades folded. (15) Lift to hangars. (16) Twin propellers and rudders.

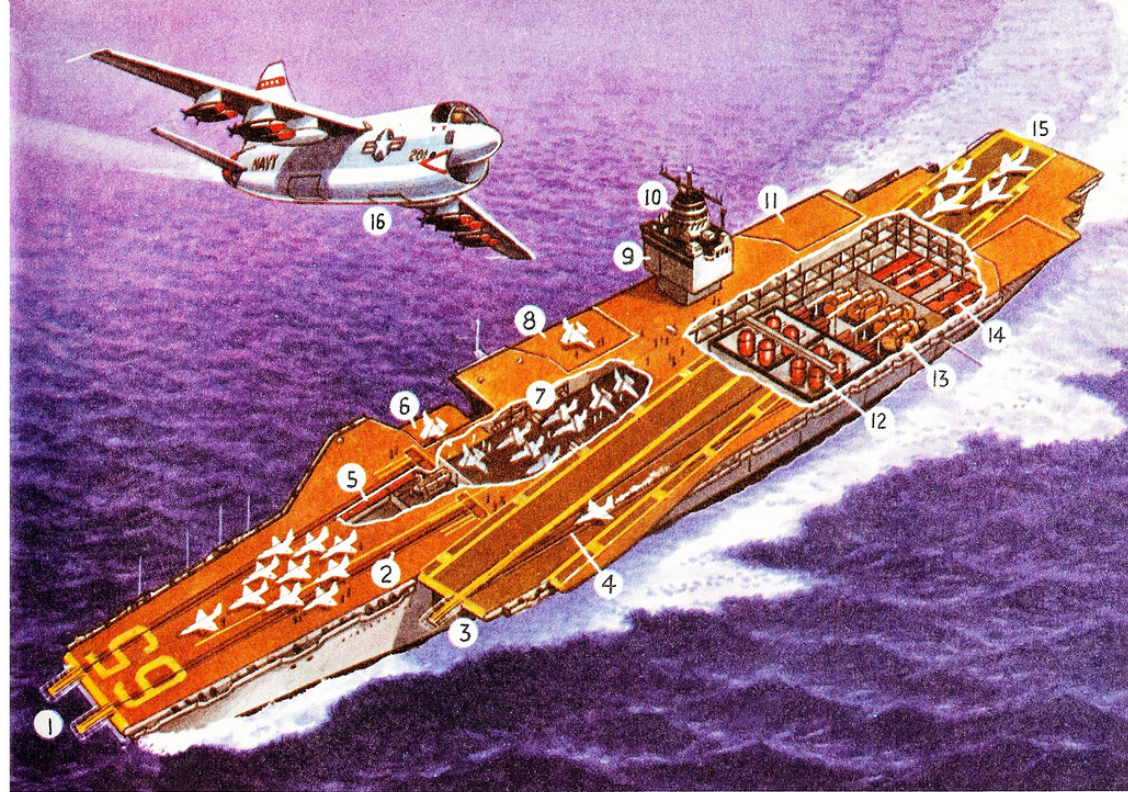


HELICOPTER CARRIER

WORLD'S BIGGEST NAVAL SHIP

"THE Big E", as the United States Navy calls her, is the world's biggest aircraft carrier — *Enterprise*. 83,350 tons fully loaded, her flight deck is a quarter of a mile long and, with four steam catapults (of British invention), she can launch an aircraft every 15 seconds. A box-shaped "island", aft of amidships, is the nerve centre; this is mounted by a 3-D radar dome, rather like a Christmas pudding. The *Enterprise* is nuclear powered by eight atomic reactors supplying steam through 32 heat exchangers to four sets of steam turbines producing 300,000 shaft h.p. to four propeller shafts and driving this giant ship at 35 knots. She can steam for three years without refuelling. Armament is guided missile launchers. Crew, 5,000 men; 100 aircraft carried. The angled deck is another British idea.

KEY TO NUMBERED PARTS
(1) Take-off extensions. (2) Forward port steam-operated catapult. The heaviest bomber can be accelerated from a standstill to 160 m.p.h. in 250 ft. (3) End of angled deck. (4) Aircraft being launched by catapult. (5) Forward starboard catapult. (6) Aircraft lift — these lifts are lowered at the extreme side of ship for access to hangars. (7) Aircraft hangar and workshops. (8) Aircraft lift. (9) "Island" with navigating bridge, flying control bridge and nuclear power remote control. (10) 3-D radar dome. (11) Aircraft lift. (12) Eight pressurised water-cooled atomic reactors with 32 heat exchangers. (13) Four sets of geared steam turbines. (14) Four propeller shafts. (15) Angled deck approach. (16) United States Navy A-7B Corsair II strike aircraft.

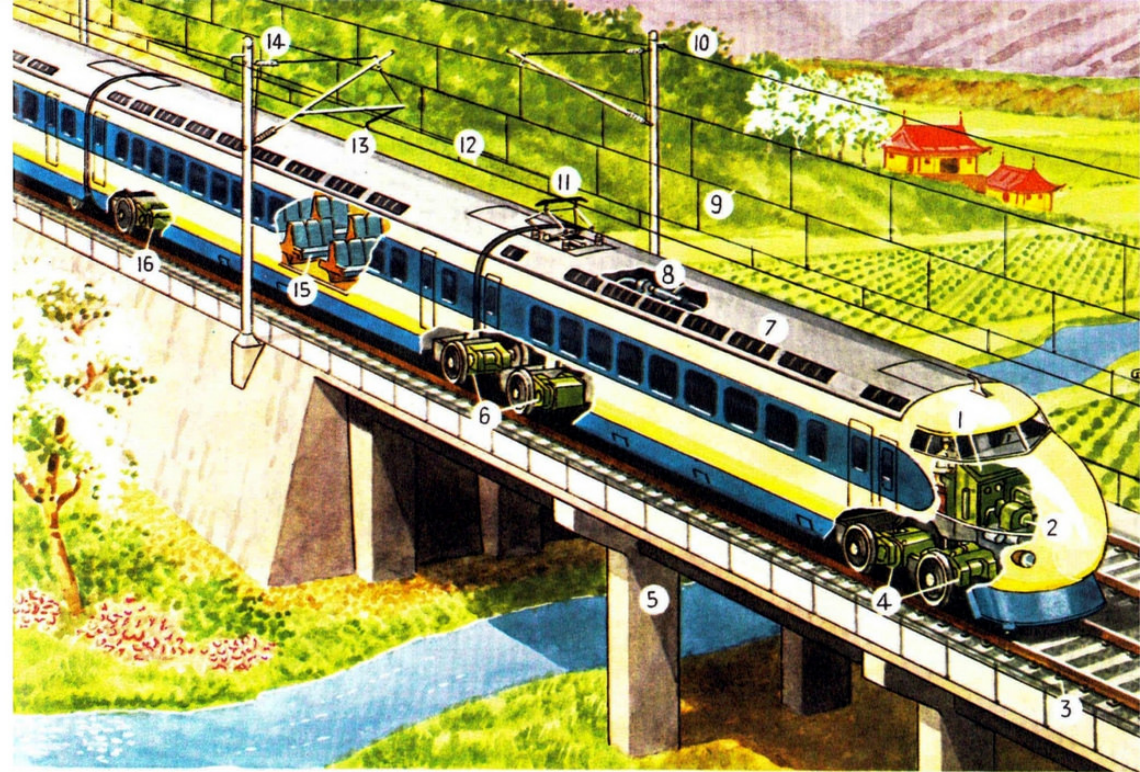


BIGGEST AIRCRAFT CARRIER

FASTEST TRAINS IN THE WORLD

ONCE every hour of the day a blue and ivory "bullet" streaks along the tracks of Japan's New Tokaido Line at 130 miles an hour. It does the 320 mile journey between Tokyo and Osaka in three hours. The Hikari Express, shown opposite emerging from the Bentanyama tunnel near Koze, has no locomotive. Instead of which, powerful electric motors, totalling 8,000 h.p. are mounted on the axles of all the carriages. They take current at 25,000 volts from an overhead wire supported by pylons along the track. The driver's cab above the bullet-nose contains the brake and speed controls and a maze of electronic circuits. Throughout the hundreds of miles of specially laid track, the train's speed is regulated by an automatic electronic system controlled at Tokyo station.

KEY TO NUMBERED PARTS
(1) Driver's cab, the only time the driver uses the controls is when the train is starting or coming to a slow halt. (2) Electronic cabinet and circuits. (3) Between the rails and every concrete sleeper there is a rubber cushion. (4) Leading wheels and electric propulsion motors. (5) Entire track is built on concrete pylons. (6) Electric motor drive. (7) Air intakes. (8) Air-conditioning equipment. (9) Suspension wire. (10) Telephone lines. (11) Pantograph picks up current from the contact wire. (12) Contact wire carrying 25,000 volt current. (13) Contact cable suspension. (14) Insulators. (15) Luxury seating in air-conditioned coaches. (16) Electric motor drive. Alongside the track is an electric cable.



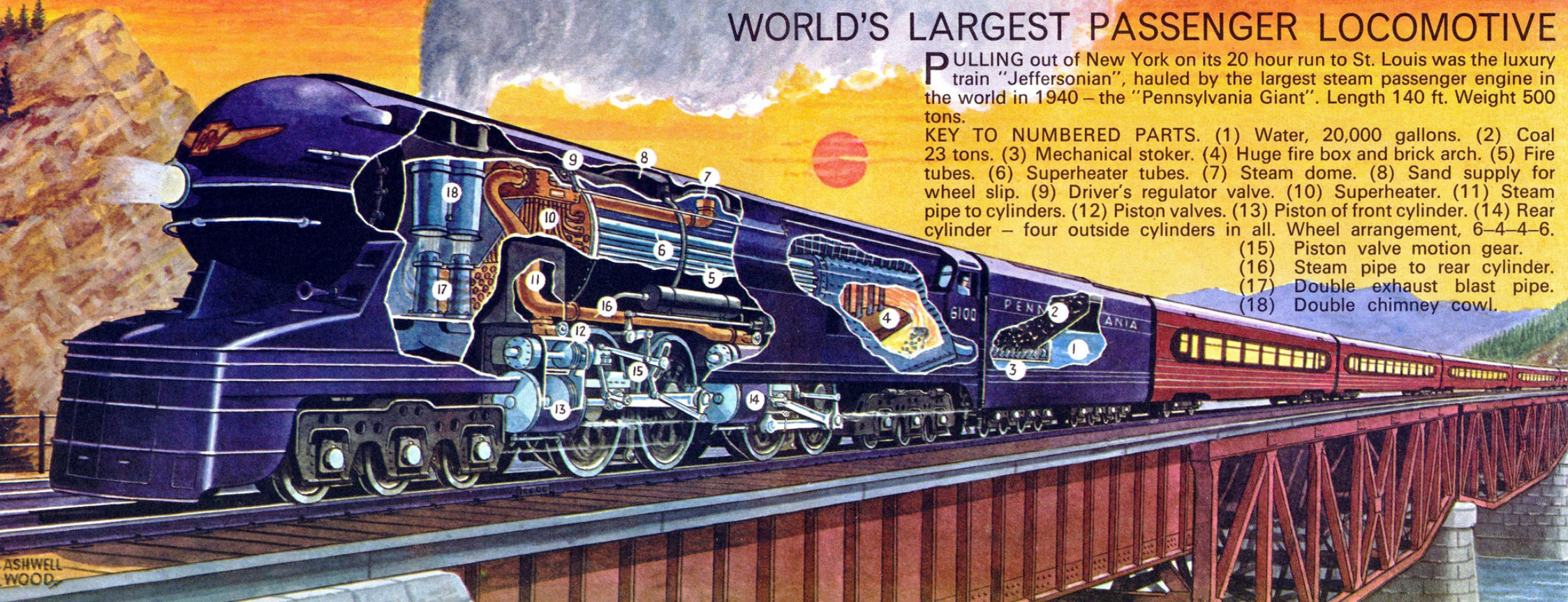
HIKARI EXPRESS
JAPANESE NATIONAL RAILWAYS

WORLD'S LARGEST PASSENGER LOCOMOTIVE

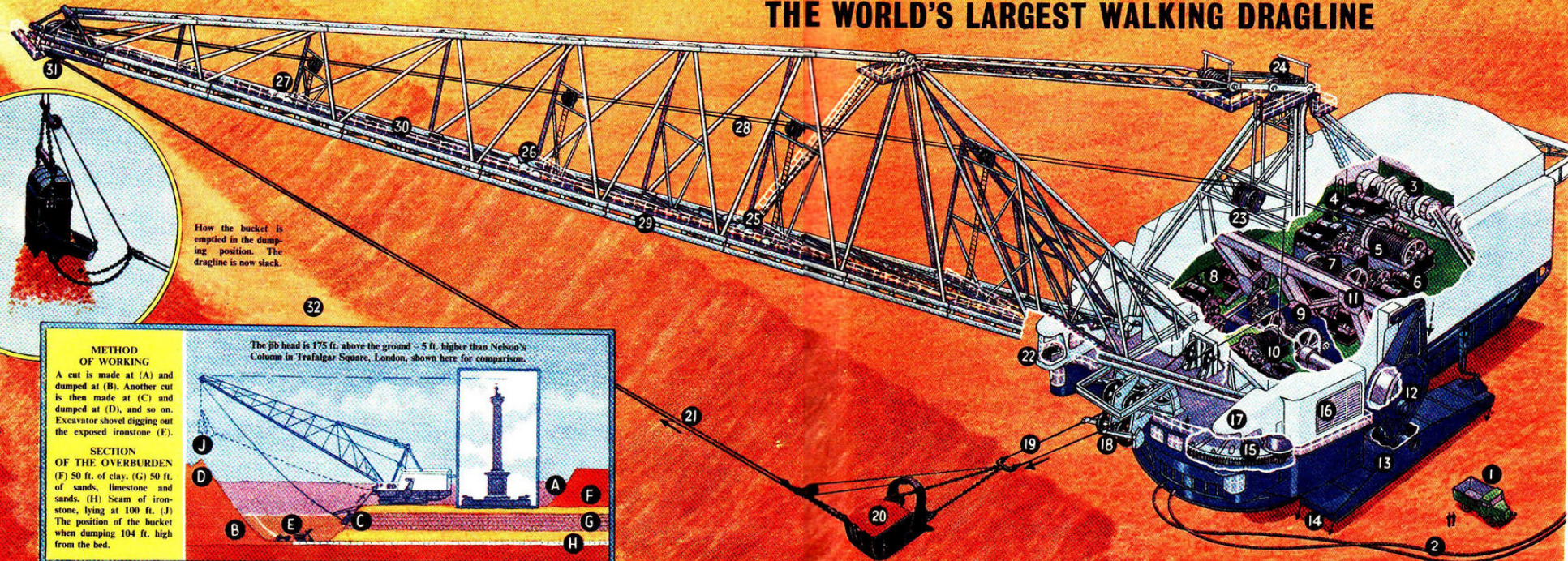
PULLING out of New York on its 20 hour run to St. Louis was the luxury train "Jeffersonian", hauled by the largest steam passenger engine in the world in 1940 – the "Pennsylvania Giant". Length 140 ft. Weight 500 tons.

KEY TO NUMBERED PARTS. (1) Water, 20,000 gallons. (2) Coal 23 tons. (3) Mechanical stoker. (4) Huge fire box and brick arch. (5) Fire tubes. (6) Superheater tubes. (7) Steam dome. (8) Sand supply for wheel slip. (9) Driver's regulator valve. (10) Superheater. (11) Steam pipe to cylinders. (12) Piston valves. (13) Piston of front cylinder. (14) Rear cylinder – four outside cylinders in all. Wheel arrangement, 6-4-4-6.

(15) Piston valve motion gear.
(16) Steam pipe to rear cylinder.
(17) Double exhaust blast pipe.
(18) Double chimney cowl.



THE WORLD'S LARGEST WALKING DRAGLINE



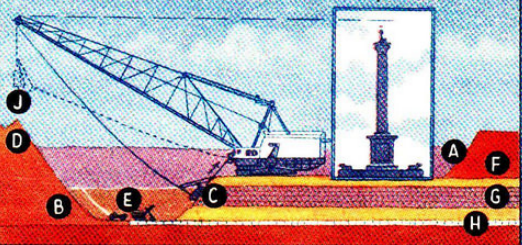
How the bucket is emptied in the dumping position. The dragline is now slack.

METHOD OF WORKING

A cut is made at (A) and dumped at (B). Another cut is then made at (C) and dumped at (D), and so on. Excavator shovel digging out the exposed ironstone (E).

SECTION OF THE OVERBURDEN
(F) 50 ft. of clay. (G) 50 ft. of sands, limestone and sands. (H) Seam of ironstone, lying at 100 ft. (J) The position of the bucket when dumping 104 ft. high from the bed.

The jib head is 175 ft. above the ground - 5 ft. higher than Nelson's Column in Trafalgar Square, London, shown here for comparison.



A remarkable achievement of British engineering skill, this huge machine can dig, lift and dump its own weight (1,600 tons) of earth every hour. It is used in Lincolnshire to extract iron-ore or ironstone from a seam 100 feet below the surface. The overburden (or top clay), sand and limestone, has first to be moved and dumped, and only a machine of this size can do it.

Ironstone is very necessary for Britain's vital iron and steel industry.

The huge bucket can dig 27 tons in one grab. The empty bucket is swung outwards and then dug into the cut and dragged inwards, hence the name dragline.

Two huge legs moved by eccentrics lift and move the whole machine forwards in 7 ft. steps. The tubular jib is 282 ft. long and its head is 175 ft. above the ground.

KEY TO HOW IT WORKS

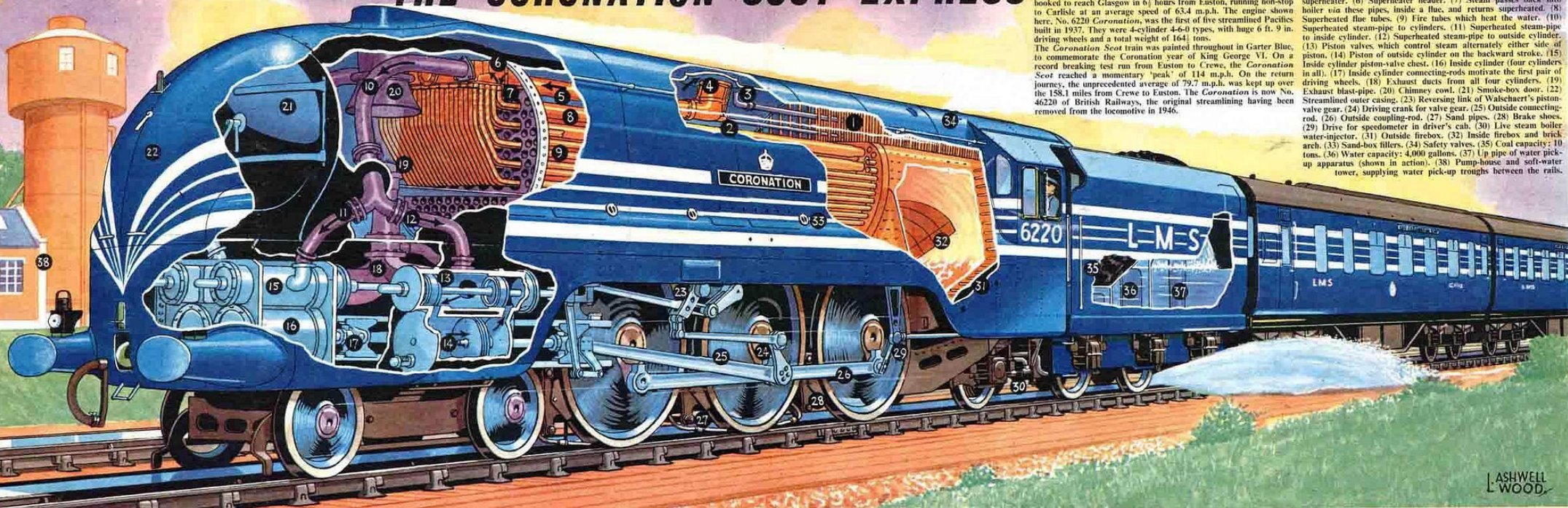
(1) A ten-ton lorry for comparison in size. (2) Two 66,000 volt cables from main supply. (3) Motor generator sets. (4) Hoist motors, 225 h.p. each. (5) Hoist drum. (6) Drag motors, 225 h.p. each. (7) Drag drum. (8) Walking gear motors, 225 h.p. each. (9) Walking gears. (10) Jib lowering drum and motors. (11) Main beam takes the weight of the walking shoes. (12) Walking gear eccentric. (13) Walking shoe. (14) The walking shoe is lowered forwards and downwards; the whole machine is then lifted and moved forwards 7 ft. at a step. (15) Rotating gear and motors. (16) Ventilators. (17) Control cabin. (18) Dragline pulleys. (19) Dragline. (20) Bucket has just been filled, with 27 tons at one dig, and is being hoisted to the dumping position. (21) Hoist lines. (22) Control cabin (all electric). (23) Hoist pulleys. (24) Jib pulleys. (25, 26, 27) Floodlights for night working. (28) Hoist lines. (29) Jib of all-tubular steel construction. (30) Catwalk. (31) Jib head and hoist pulleys. (32) Bed of ironstone uncovered. This is later dug out by a small excavator shovel, as shown below at (E).

THE CORONATION SCOT EXPRESS

A new chapter in British railway history was written in the summer of 1937, when streamlined express trains began to run between England and Scotland. The L.M.S. express *Coronation Scot* was booked to reach Glasgow in 6½ hours from Euston, running non-stop to Carlisle at an average speed of 63.4 m.p.h. The engine shown here, No. 6220 *Coronation*, was the first of five streamlined Pacifics built in 1937. They were 4-cylinder 4-6-0 types, with huge 6 ft. 9 in. driving wheels and a total weight of 164 tons.

The *Coronation Scot* train was painted throughout in Garter Blue, to commemorate the Coronation year of King George VI. On a record breaking test run from Euston to Crewe, the *Coronation Scot* reached a momentary 'peak' of 114 m.p.h. On the return journey, the unprecedented average of 79.7 m.p.h. was kept up over the 158.1 miles from Crewe to Euston. The *Coronation* is now No. 46220 of British Railways, the original streamlining having been removed from the locomotive in 1946.

KEY TO NUMBERED PARTS: (1) Water level over firebox. (2) Regulating rod from driver's cab. (3) Steam pipe to water injectors for boiler. (4) Regulator valve admits steam to steam-pipe. (5) Steam-pipe to superheater. (6) Superheater header. (7) Steam passes back into boiler via these pipes, inside a flue, and returns superheated. (8) Superheated flue tubes. (9) Fire tubes which heat the water. (10) Superheated steam-pipe to cylinders. (11) Superheated steam-pipe to inside cylinder. (12) Superheated steam-pipe to outside cylinder. (13) Piston valves which control steam alternately either side of piston. (14) Piston of outside cylinder on the backward stroke. (15) Inside cylinder piston-valve chest. (16) Inside cylinder (four cylinders in all). (17) Inside cylinder connecting-rods motivate the first pair of driving wheels. (18) Exhaust ducts from all four cylinders. (19) Exhaust blast-pipe. (20) Chimney cowl. (21) Smoke-box door. (22) Streamlined outer casing. (23) Reversing link of Walschaert's piston-valve gear. (24) Driving crank for valve gear. (25) Outside connecting-rod. (26) Outside coupling-rod. (27) Sand pipes. (28) Brake shoes. (29) Drive for speedometer in driver's cab. (30) Live steam boiler water-injector. (31) Outside firebox. (32) Inside firebox and brick arch. (33) Sand-box fillers. (34) Safety valves. (35) Coal capacity: 10 tons. (36) Water capacity: 4,000 gallons. (37) Up pipe of water pick-up apparatus (shown in action). (38) Pump-house and soft-water tower, supplying water pick-up troughs between the rails.



KEY TO NUMBERED PARTS

(1) Water feed pipe from tender (each side). (2) Water clack valves. (3) Water delivery trays to boiler. (4) Water level over firebox. (5) Driver's regulator rod. (6) Steam entry to steam pipe. (7) Safety valves. (8) Steam pipe to regulator valve. (9) Driver's regulator valve. (10) Steam pipe to superheater. (11) Superheater header. (12) Superheater flues. Steam passes back into boiler via pipes inside the flues, and returns superheated. (13) Fire tubes, which heat the water. (14) Superheated steam pipe to cylinders (each side). (15) Piston valves, which admit steam either side of piston alternately, and also allow exhaust to escape. (16) Piston. (17) Cylinder condensation drain-cocks. (18) Exhaust blast-pipe from both cylinders. (19) Path of draught gases and smoke through smoke-box. (20) Chimney bell and exhaust pipe from vacuum brake air-ejector in cab. (21) Connecting rod to driving wheels. (22) Coupling rod. (23) Forward and reverse eccentrics, for operating the piston valve motion - two eccentrics to each cylinder. (24) Expansion link; this is lowered for forward gear, and raised for reverse gear. (25) Reversing

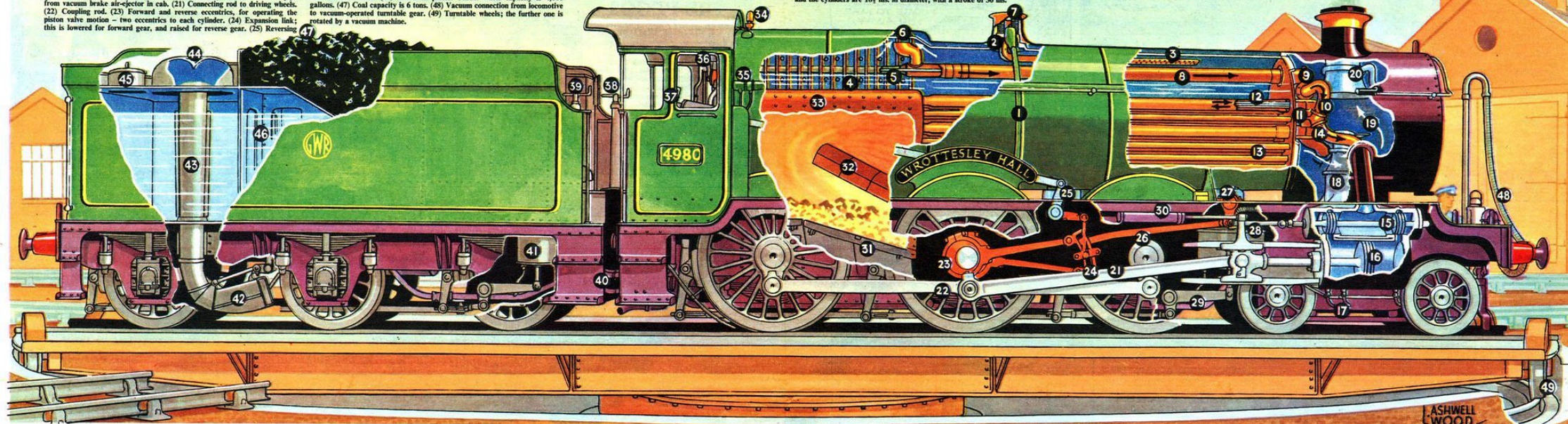
rod from driver's cab, connected to expansion link. (26) Extension rod to piston valve spindle. (27) Valve rocker-arm. (28) Piston valve spindle. (29) Brake operating-arm, connected to vacuum brake cylinder. (30) Vacuum pump. (31) Fire-grate and ash-pans, the front of which opens to form a draught. (32) Brick arch. (33) Inner firebox. (34) Whistle. (35) Vacuum brake air ejector - exhaust to smoke-box. (36) Driver's vacuum brake handle and regulator handle. (37) Reversing gear. (38) Water pick-up scoop handle. (39) Tender hand-brake handle. (40) Water and vacuum pipe connections. (41) Tender vacuum brake cylinder. (42) Water pick-up scoop, raised. (43) Water pick-up scoop, uptake. (44) Water deflector dome into tender. (45) Normal water-filler. (46) Anti-swill plates. Tender water capacity is 4,000 gallons. (47) Coal capacity is 6 tons. (48) Vacuum connection from locomotive to vacuum-operated turntable gear. (49) Turntable wheels; the further one is rotated by a vacuum machine.

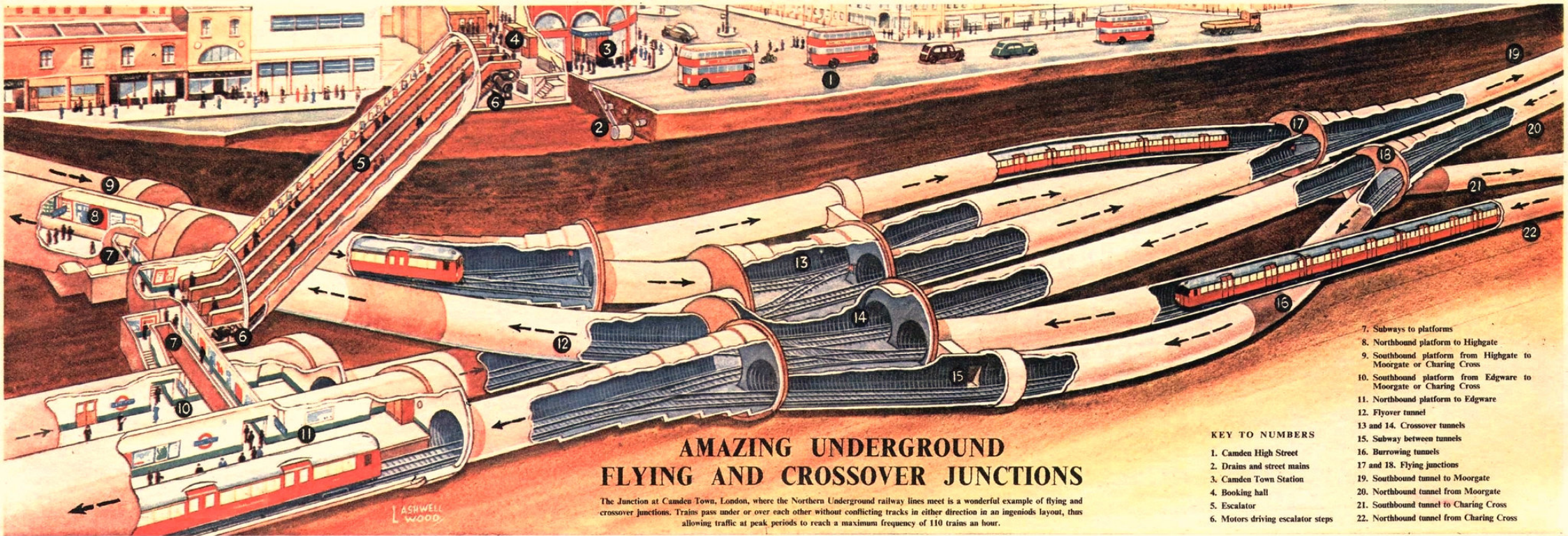
A FAMOUS LOCOMOTIVE TYPE

THE TWO-CYLINDER 4-6-0 'HALL' CLASS

Introduced in 1928, the 'Hall' (4900) class locomotives, of the then Great Western Railway, were built after the famous 'Castles' and 'Kings', and intended for mixed traffic and excursion work. They were named after well-known halls on the G.W.R. system; altogether, 258 were built, plus 71 of the modified 'Hall' class.

These locomotives are of clean design, and this drawing is a good example, in a concise way, of the principles of steam locomotive practice. The 'Halls' weigh 121 tons, 14 cwt., and are 63 ft. 0½ ins. long. The driving wheels are 6 ft. in diameter; the boiler pressure is 225 lbs. per sq. in.; and the cylinders are 18½ ins. in diameter, with a stroke of 30 ins.





AMAZING UNDERGROUND FLYING AND CROSSOVER JUNCTIONS

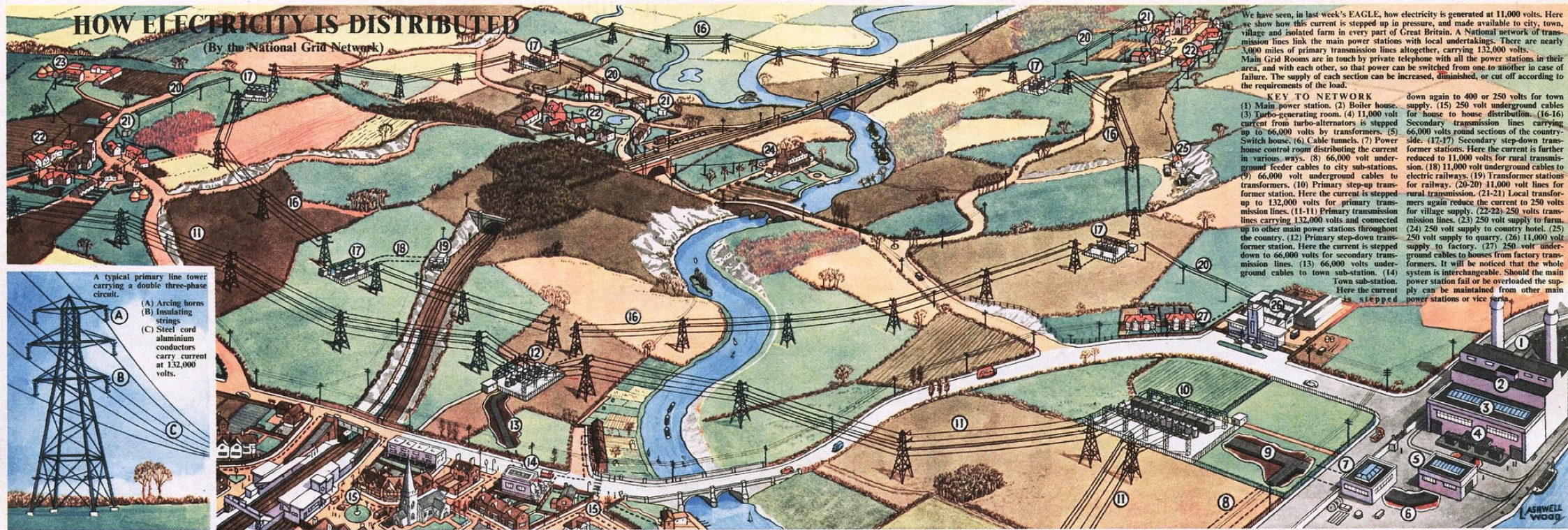
The Junction at Camden Town, London, where the Northern Underground railway lines meet is a wonderful example of flying and crossover junctions. Trains pass under or over each other in an ingenious layout, thus allowing traffic at peak periods to reach a maximum frequency of 110 trains an hour.

KEY TO NUMBERS

1. Camden High Street
2. Drains and street mains
3. Camden Town Station
4. Booking hall
5. Escalator
6. Motors driving escalator steps
7. Subways to platforms
8. Northbound platform to Highgate
9. Southbound platform from Highgate to Moorgate or Charing Cross
10. Southbound platform from Edgware to Moorgate or Charing Cross
11. Northbound platform to Edgware
12. Flyover tunnel
- 13 and 14. Crossover tunnels
15. Subway between tunnels
16. Burrowing tunnels
- 17 and 18. Flying junctions
19. Southbound tunnel to Moorgate
20. Northbound tunnel from Moorgate
21. Southbound tunnel to Charing Cross
22. Northbound tunnel from Charing Cross

HOW ELECTRICITY IS DISTRIBUTED

(By the National Grid Network)



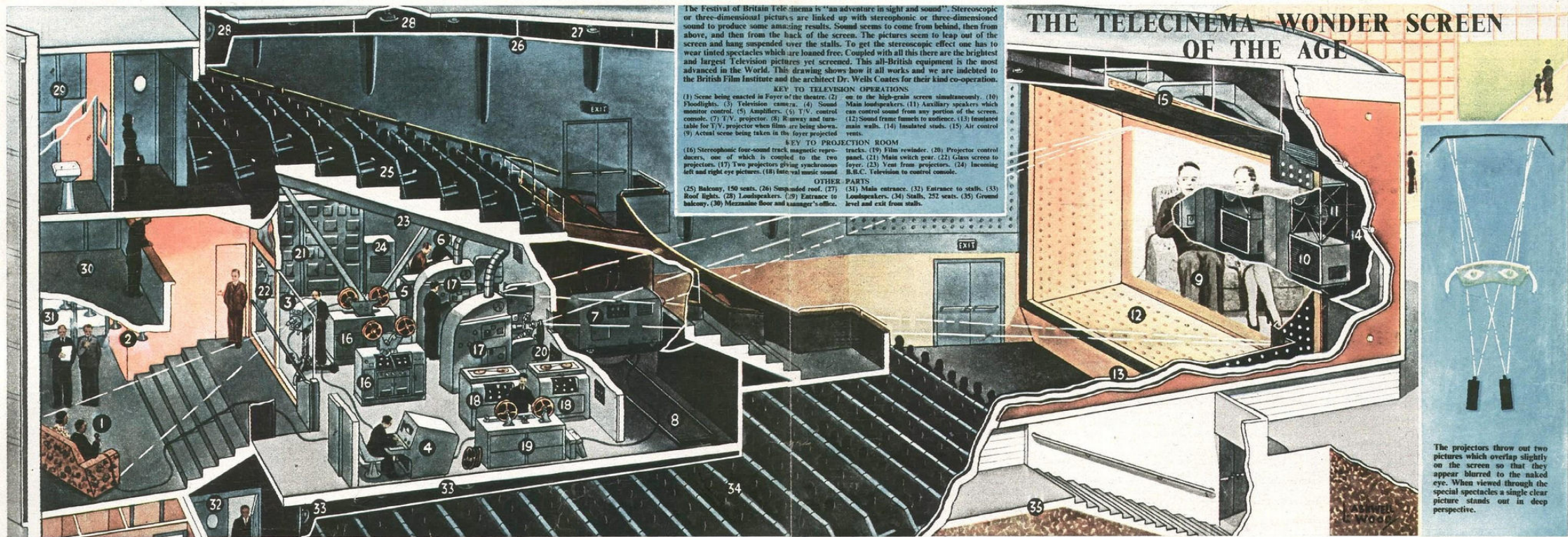
A typical primary line tower carrying a double three-phase circuit.

- (A) Arcing horns
- (B) Insulating strings
- (C) Steel cord aluminium conductors carry current at 132,000 volts.

We have seen, in last week's *EAGLE*, how electricity is generated at 11,000 volts. Here we show how this current is stepped up in pressure, and made available to city, town, village and isolated farm in every part of Great Britain. A National network of transmission lines link the main power stations with local undertakings. There are nearly 3,000 miles of primary transmission lines altogether, carrying 132,000 volts. Main Grid Rooms are in touch by private telephone with all the power stations in their area, and with each other, so that power can be switched from one to another in case of failure. The supply of each section can be increased, diminished, or cut off according to the requirements of the load.

KEY TO NETWORK

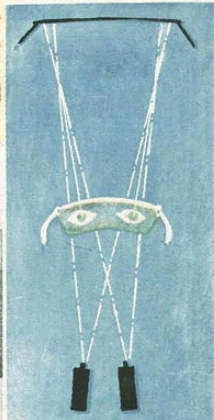
- (1) Main power station. (2) Boiler house. (3) Turbo-generating room. (4) 11,000 volt current from turbo-alternators is stepped up to 66,000 volts by transformers. (5) Switch house. (6) Cable tunnels. (7) Power house control room distributing the current in various ways. (8) 66,000 volt underground feeder cables to city sub-stations. (9) 66,000 volt underground cables to transformers. (10) Primary step-up transformer station. Here the current is stepped up to 132,000 volts for primary transmission lines. (11-11) Primary transmission lines carrying 132,000 volts and connected up to other main power stations throughout the country. (12) Primary step-down transformer station. Here the current is stepped down to 66,000 volts for secondary transmission lines. (13) 66,000 volts underground cables to town sub-station. (14) Town sub-station. Here the current is stepped
- down again to 400 or 250 volts for town supply. (15) 250 volt underground cables for house to house distribution. (16-16) Secondary transmission lines carrying 66,000 volts round sections of the countryside. (17-17) Secondary step-down transformer stations. Here the current is further reduced to 11,000 volts for rural transmission. (18) 11,000 volt underground cables to electric railways. (19) Transformer stations for railway. (20-20) 11,000 volt lines for rural transmission. (21-21) Local transformers again reduce the current to 250 volts for village supply. (22-22) 250 volts transmission lines. (23) 250 volt supply to farm. (24) 250 volt supply to country hotel. (25) 250 volt supply to quarry. (26) 11,000 volt supply to factory. (27) 250 volt underground cables to houses from factory transformers. It will be noticed that the whole system is interchangeable. Should the main power station fail or be overloaded the supply can be maintained from other main power stations or vice versa.



The Festival of Britain Telecinema is "an adventure in sight and sound". Stereoscopic or three-dimensional pictures are linked up with stereophonic or three-dimensional sound to produce some amazing results. Sound seems to come from behind, then from above, and then from the back of the screen. The pictures seem to leap out of the screen and hang suspended over the stalls. To get the stereoscopic effect one has to wear tinted spectacles which are loaned free. Coupled with all this there are the brightest and largest Television pictures yet screened. This all-British equipment is the most advanced in the World. This drawing shows how it all works and we are indebted to the British Film Institute and the architect Dr. Wells Coates for their kind co-operation.

- KEY TO TELEVISION OPERATIONS**
- (1) Scene being enacted in Foyer of the theatre. (2) Floodlights. (3) Television camera. (4) Sound monitor control. (5) Amplifiers. (6) T.V. control console. (7) T.V. projector. (8) Runway and turntable for T.V. projector when films are being shown. (9) Actual scene being taken in the foyer projected on to the high-grain screen simultaneously. (10) Main loudspeakers. (11) Auxiliary speakers which can control sound from any portion of the screen. (12) Sound frame funnel to audience. (13) Insulated main walls. (14) Insulated studs. (15) Air control vents.
- KEY TO PROJECTION ROOM**
- (16) Stereophonic four-sound track, magnetic reproducers, one of which is coupled to the two projectors. (17) Two projectors giving synchronous left and right eye pictures. (18) Into-val music sound tracks. (19) Film rewriter. (20) Projector control panel. (21) Main switch gear. (22) Glass screen to foyer. (23) Vest from projectors. (24) Incoming B.B.C. Television to control console.
- OTHER PARTS**
- (25) Balcony, 150 seats. (26) Suspended roof. (27) Roof lights. (28) Loudspeakers. (29) Entrance to balcony. (30) Mezzanine floor and manager's office. (31) Main entrance. (32) Entrance to stalls. (33) Loudspeakers. (34) Stalls, 252 seats. (35) Ground level and exit from stalls.

THE TELECINEMA—WONDER SCREEN OF THE AGE



The projectors throw out two pictures which overlap slightly on the screen so that they appear blurred to the naked eye. When viewed through the special spectacles a single clear picture stands out in deep perspective.

ASHLEY L. WOOD

VOLCANOES - THE WORLD'S GREATEST EXPLOSION

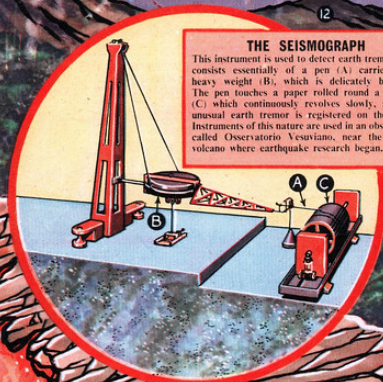


During the International Geophysical Year - which lasts from 30th June, 1957, until December, 1958 - the greatest concerted effort ever made to observe the world is being undertaken by thousands of scientists in sixty-three nations. H.R.H. Prince Philip reviewed this enthralling undertaking in a recent television programme entitled *The Restless Spheres*. Among the many items of interest, H.R.H. described the study of earthquakes, or the science of seismology as it is called. The causes of earthquakes are still unknown and, in an effort to gain more information, a combined study of volcanoes is being made. The volcano Vesuvius, which was featured in *The Restless Spheres*, is attracting particular attention. No one knows when it will again erupt. Its last major eruption was in 1944, when most of San Sebastiano village was wrecked. Through the centuries, it has been threateningly active, and has changed its shape on many occasions since the disastrous earthquake of A.D.79, when it completely obliterated Pompeii and Herculaneum. Our main drawing shows its probable interior arrangement.

KEY TO NUMBERS

(1) Clouds of vapour, each due to separate explosions. (2) Lightning flashes caused by enormous friction between ejected rocks. (3) Molten lava flowing over the lip of the crater at 9 ft. per second. (4) Encircling crater ring of somma, 3 miles across. (5) Layers of volcanic material ejected from the cone. (6) Southern half of somma blown away in A.D.79. (7) Plug of lava that filled crater after A.D.79. (8) Line of crater after the eruption of A.D.79. (9) Crater here about A.D.1600. (10) Line of crater about 1822. (11) Molten lava. (12) Lava flowed for five miles in A.D.79. (13) Accumulations of volcanic material. (14) Lava beds of pre-historic times. (15) When lava weathers into fine dust, it forms a rich and fertile soil. (16) Heated, stratified rock kept solid by enormous pressure. (17) Heated rocks expanding and forming molten lava.

FISHER



THE SEISMOGRAPH

This instrument is used to detect earth tremors, and consists essentially of a pen (A) carried on a heavy weight (B), which is delicately balanced. The pen touches a paper rolled round a cylinder (C) which continuously revolves slowly, and any unusual earth tremor is registered on the paper. Instruments of this nature are used in an observatory called Osservatorio Vesuviano, near the famous volcano where earthquake research began.



BEFORE THE EXPLOSION IN 1883.



AFTER THE EXPLOSION.

THE WORLD'S GREATEST EXPLOSION

Estimated to have had over a hundred times the power of the largest H-bomb detonation, the greatest explosion in history occurred on Krakatoa Island, in the Strait of Sunda near Sumatra, on 27th August, 1883. Two-thirds of the island were torn away and great waves, some 50 ft. high, were caused in the sea. One of these travelled across half the globe and reached the coasts of England and France! Dust from the explosion travelled three times round the earth, and the noise of the great burst was heard 3,000 miles away; ashes fell on a ship 1,600 miles from Krakatoa! The probable cause of this gigantic upheaval was water from the ocean finding its way into the interior of the earth through fissures opened by previous earthquakes. The water met the molten material rising from below, was immediately converted into steam, and the explosion followed. Volcanoes are, in fact, openings in the earth's crust which act as safety valves for the tremendous pressures in the earth's interior. By the combined study planned for the I.G.Y., it is hoped that scientists will be able to understand more clearly the causes of these terrible eruptions and learn more of the secrets hidden deep in the earth's core.

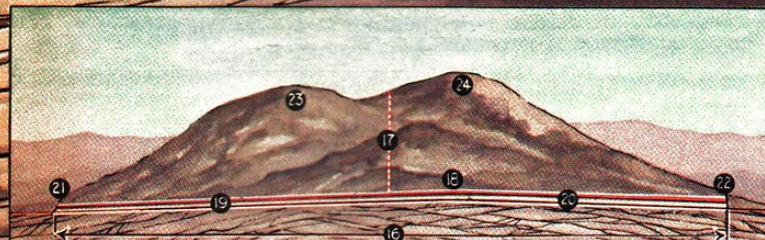
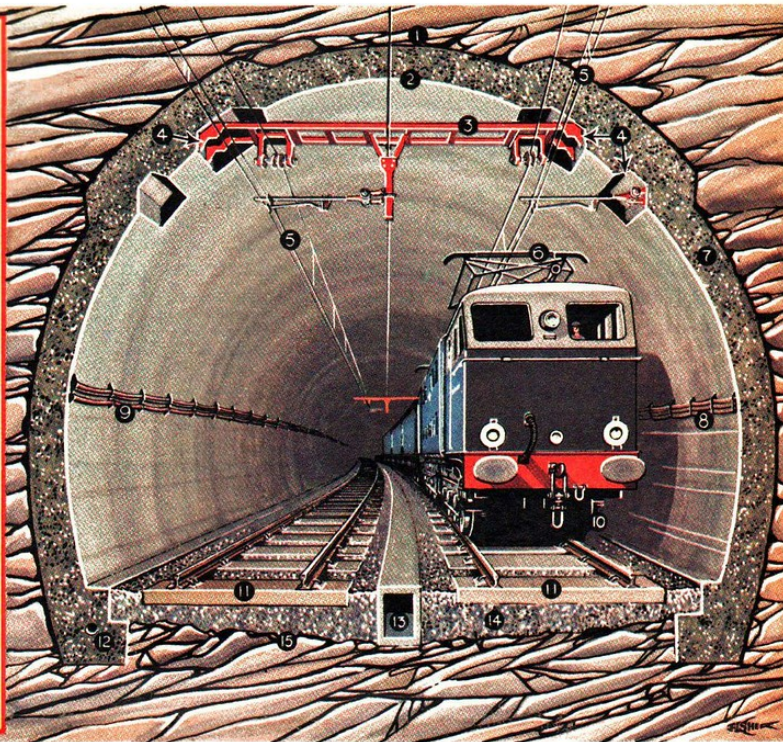
THE NEW WOODHEAD TUNNEL

Piercing 'the backbone of England'—the Pennine Range—the new Woodhead Tunnel is one of the outstanding engineering achievements of post-war years. It runs alongside the twin bores of two earlier single-line tunnels, which have now been abandoned because of their age and condition.

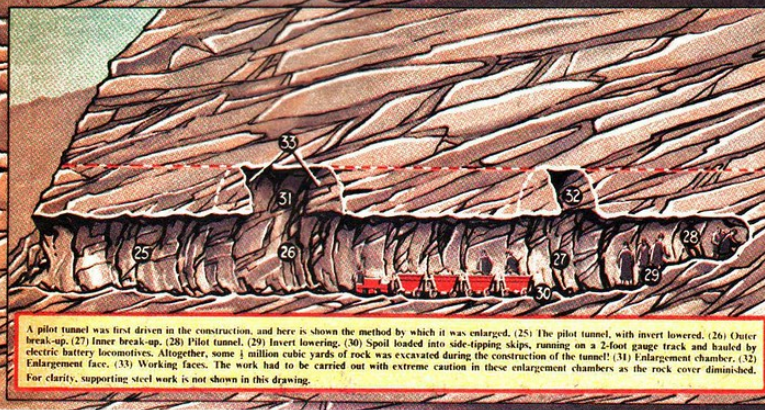
The new tunnel, double-tracked throughout, is fitted with overhead electrification, in conjunction with the Manchester-Sheffield-Wath on Dearne route on which it lies. Work on this great project commenced in February, 1949, and the tunnel was opened to traffic in June, 1954. Excluding the London Transport Tube tunnels, the new Woodhead Tunnel, which is 3 miles 66 yards long, is the third longest in the country. Only the Severn (4 miles 628 yards) and the Totley (3 miles 950 yards) are longer. In order to carry out a construction job of this magnitude in a location several miles from the nearest town, bleak and desolate in winter, a small township was erected at the Dunford Bridge end of the tunnel to accommodate 1,100 workmen, engineering and office staffs. It included a cinema, recreation room, canteens, retail store and post office! All this has vanished, now that the work is completed. Powerful electric locomotives regularly haul trains on a route that was previously worked by steam. This is in accordance with the scheme for reorganizing and modernizing British Railways. Our main drawing shows a typical section through the tunnel.

KEY TO NUMBERS ON MAIN DRAWING

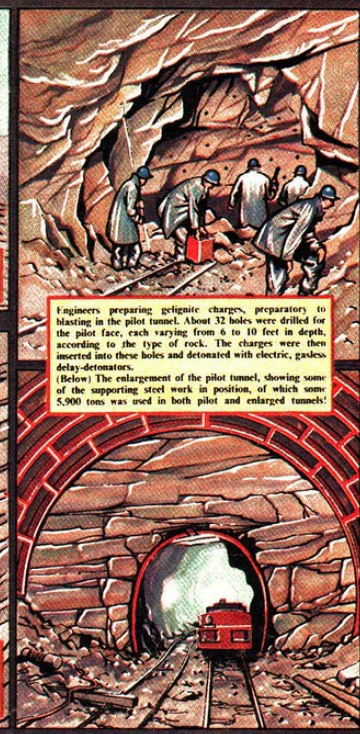
(1) Maximum height of excavation, 26 feet 4 inches. (2) Height above rails, 20 feet 7 inches. (3) Steel booms supporting overhead-line traction equipment. (4) Recesses for overhead electrical equipment. These are normally located at 146 foot intervals. (5) Catenary and cadmium copper contact wires. (6) Overhead wiring conveys 1,500 volts D.C. to the pantographs of passing locomotives. The contact height is a uniform 15 feet. (7) Pantograph on locomotive, through which current is collected. (8) Minimum thickness of tunnel wall, 21 inches. (9) Signal and telecommunication cables, including a twin lead cable for emergency telephones within the tunnel. (10) Transmission cables supplying electricity to traction substations. (11) One of the 2,500 H.P. electric locomotives used on the Manchester-Sheffield-Wath electrification. These locos weigh over 100 tons and have two, three-axle bogies, each equipped with three 415 H.P. motors. (12) When the tracks in the tunnel were laid, one was laid by hand, the other prefabricated and put down by a track-layer hauled to the site by a diesel-electric locomotive. (13) Haunch drain. (14) Centre drain. (15) Ballast. (16) Rock base sloping downwards to centre drain.



This diagram shows the longitudinal section of the tunnel. (16) The length of the tunnel is 3 miles 66 yards. (17) Position of the main ventilation shaft. (18) Grade summit. (19) Gradient of 1 in 129 up. (20) Gradient of 1 in 1,186 down. (21) West portal—Woodhead. (22) East portal—Dunford Bridge. (23) Pikeaze Moor 1,480 feet. (24) Dearden Moss—1,530 feet.

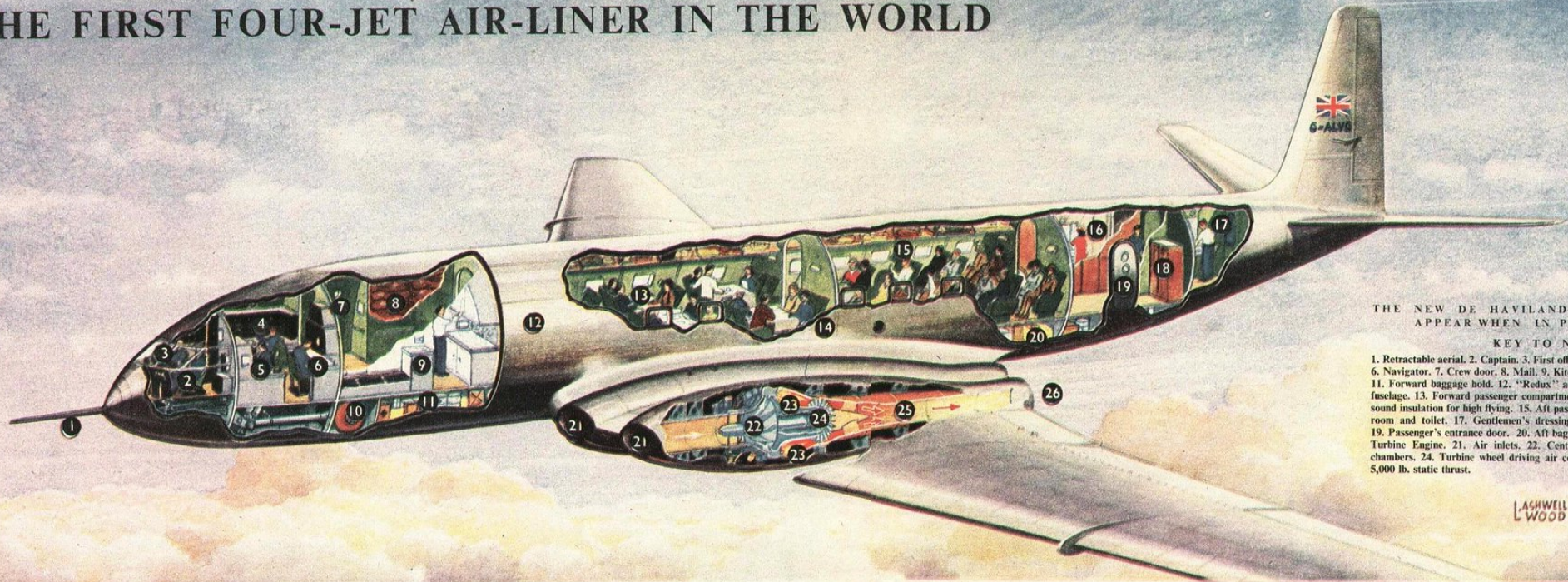


A pilot tunnel was first driven in the construction, and here is shown the method by which it was enlarged. (25) The pilot tunnel, with invert lowered. (26) Outer break-up. (27) Inner break-up. (28) Pilot tunnel. (29) Invert lowering. (30) Spoil loaded into side-tipping skips, running on a 2-foot gauge track and hauled by electric battery locomotives. Altogether, some 1 million cubic yards of rock was excavated during the construction of the tunnel! (31) Enlargement chamber. (32) Enlargement face. (33) Working faces. The work had to be carried out with extreme caution in these enlargement chambers as the rock cover diminished. For clarity, supporting steel work is not shown in this drawing.



Engineers preparing gelignite charges, preparatory to blasting in the pilot tunnel. About 32 holes were drilled for the pilot face, each varying from 6 to 10 feet in depth, according to the type of rock. The charges were then inserted into these holes and detonated with electric, gasless delay-detectors. (Below) The enlargement of the pilot tunnel, showing some of the supporting steel work in position, of which some 5,900 tons was used in both pilot and enlarged tunnels!

THE FIRST FOUR-JET AIR-LINER IN THE WORLD



THE NEW DE HAVILLAND "COMET" AS IT MIGHT
APPEAR WHEN IN PASSENGER SERVICE

KEY TO NUMBERS

1. Retractable aerial. 2. Captain. 3. First officer. 4. Radio operator. 5. Flight engineer. 6. Navigator. 7. Crew door. 8. Mail. 9. Kitchen. 10. Nose landing wheels (retracted). 11. Forward baggage hold. 12. "Redux" adhesive used to cement metal to metal on fuselage. 13. Forward passenger compartment. 14. Double skin for temperature and sound insulation for high flying. 15. Aft passenger compartment. 16. Ladies' dressing room and toilet. 17. Gentlemen's dressing room and toilet. 18. Wardrobe room. 19. Passenger's entrance door. 20. Aft baggage hold. De Havilland "GHOST" Gas Turbine Engine. 21. Air inlets. 22. Centrifugal air compressor. 23. Combustion chambers. 24. Turbine wheel driving air compressor. 25. Jet pipe. 26. Jet orifice, 5,000 lb. static thrust.

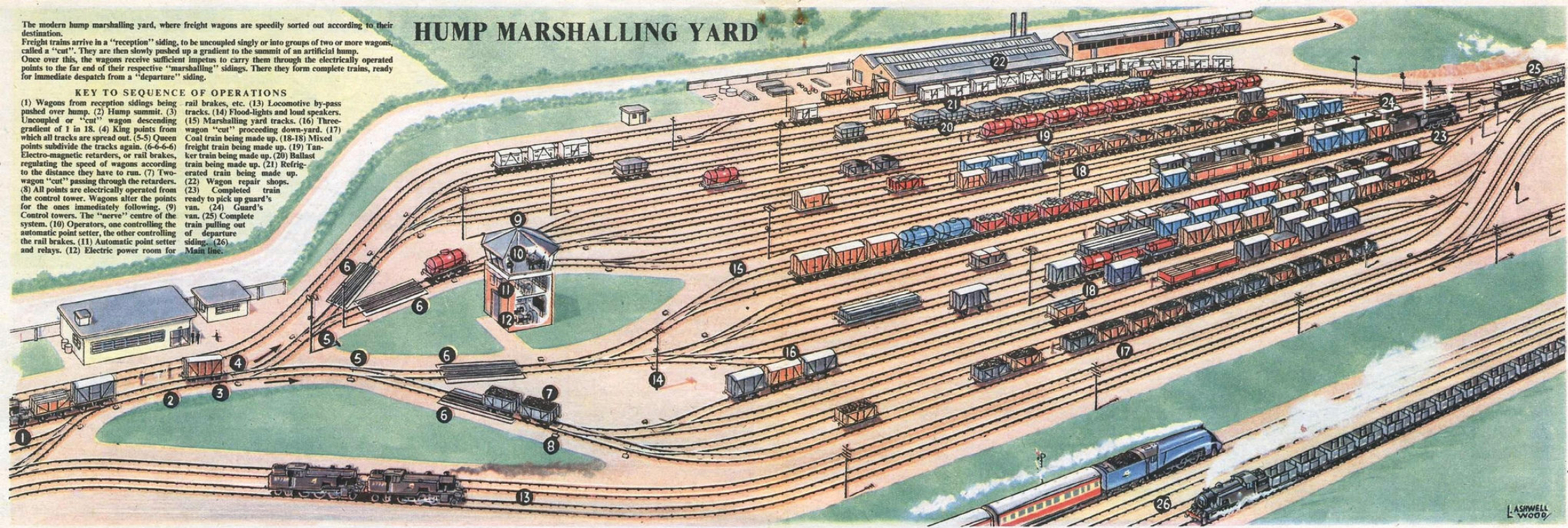
LASHWELL
WOOD

The modern hump marshalling yard, where freight wagons are speedily sorted out according to their destination. Freight trains arrive in a "reception" siding, to be uncoupled singly or into groups of two or more wagons, called a "cut". They are then slowly pushed up a gradient to the summit of an artificial hump. Once over this, the wagons receive sufficient impetus to carry them through the electrically operated points to the far end of their respective "marshalling" sidings. There they form complete trains, ready for immediate despatch from a "departure" siding.

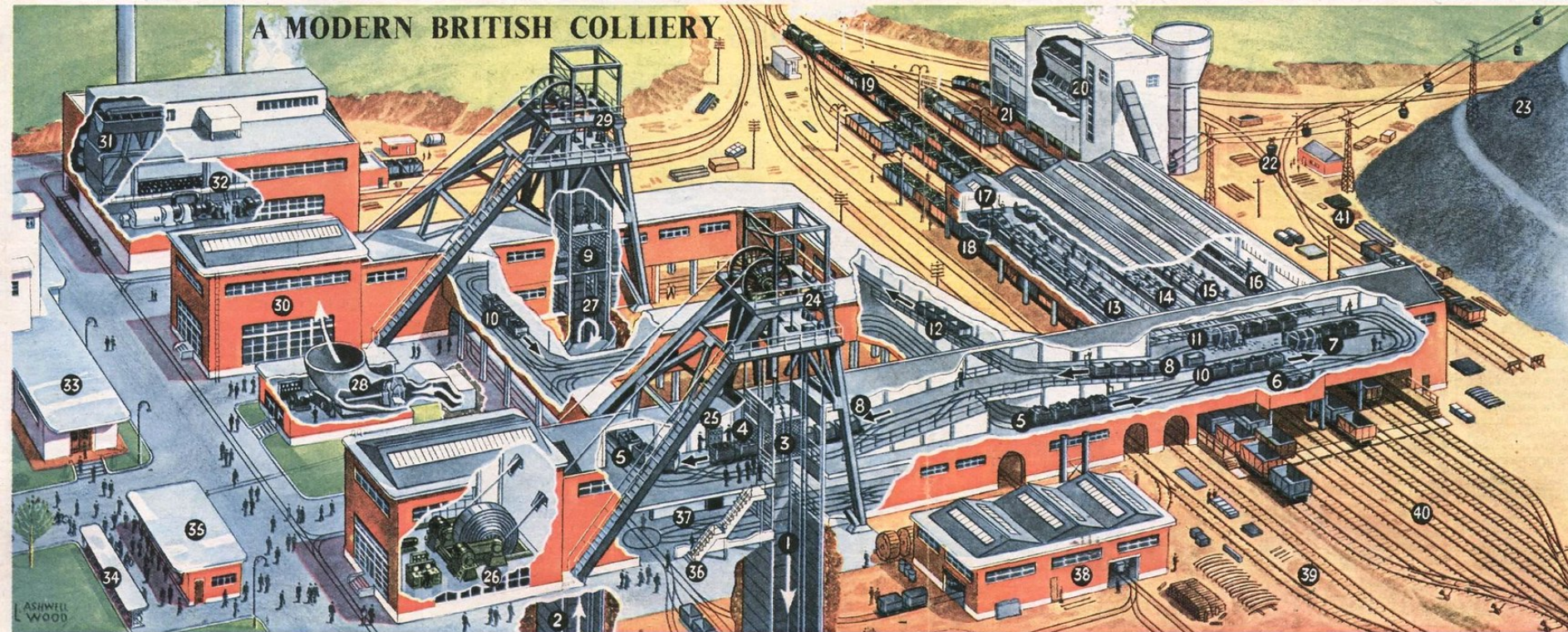
KEY TO SEQUENCE OF OPERATIONS

(1) Wagons from reception sidings being pushed over hump. (2) Hump summit. (3) Uncoupled or "cut" wagon descending gradient of 1 in 18. (4) King points from which all tracks are spread out. (5-5) Queen points subdivide the tracks again. (6-6-6-6) Electro-magnetic retarders, or rail brakes, regulating the speed of wagons according to the distance they have to run. (7) Two-wagon "cut" passing through the retarders. (8) All points are electrically operated from the control tower. Wagons alter the points for the ones immediately following. (9) Control towers. The "nerve" centre of the system. (10) Operators, one controlling the automatic point setter, the other controlling the rail brakes. (11) Automatic point setter and relays. (12) Electric power room for rail brakes, etc. (13) Locomotive by-pass tracks. (14) Flood-lights and loud speakers. (15) Marshalling yard tracks. (16) Three-wagon "cut" proceeding down-yard. (17) Coal train being made up. (18-18) Mixed freight train being made up. (19) Tanker train being made up. (20) Ballast train being made up. (21) Refrigerated train being made up. (22) Wagon repair shops. (23) Completed train ready to pick up guard's van. (24) Guard's van. (25) Complete train pulling out of departure siding. (26) Main line.

HUMP MARSHALLING YARD



A MODERN BRITISH COLLIERY



For millions of years the coal which we burn has been embedded in the earth's crust, and the methods of winning this coal have been subject to continual experiment and research by mining engineers.

A modern colliery is planned to ensure the minimum waste of time and labour. The illustration shows a typical example of a modern coal mine at the surface. Several such mines have been built in Great Britain.

In next week's issue of EAGLE we shall continue the story below ground, showing the actual winning of the coal.

KEY TO THE PROGRESSIVE OPERATIONS AT PIT HEAD

(1) Downcast shaft. (2) Upcast shaft (these relate to the air supply; the cages go up and down in both). (3) Cage raised. (4) Full tubs, or "trams" as they are called, pushed out by empty tubs the other side. (5) Full tubs gravitate to screens by a slight fall in level. (6) Weighbridge. (7) Tippler which turns the full tubs upside down. The coal, falling on to screens which have holes of several sizes like a huge sieve, is graded into four sizes - Large, Cobbles, Nuts and Smalls. (8) Empty tubs returned to cage (hauled up slopes by cable). (9) Cage raised. (10) Full tubs to screens. (11) Tippler. (12) Empty tubs returned to cage. (13) Large coal conveyor belt from screens. On this, and the two following belts, stone, slate etc. is picked out. (14) Cobbles conveyor. (15) Nuts conveyor. (16) Smalls conveyor. This coal being too small to be picked is passed on to the washery. (17) Conveyor jib to hopper. (18) Wagon being filled from hopper. As each wagon is filled the wagon man moves another forward down the slight incline of the sidings. (19) Graded coal train despatched to destination. (20) Smalls washery. Here the shale, stone etc. sinks to the bottom of the machine. (21) Washed smalls hopper to wagons. (22) Stone waste etc. from picking belts, conveyed to slag heap. (23) Slag heap.

KEY TO OTHER PARTS

(24) Downcast shaft head gear. (25) Banksman in charge of cages. (26) Conical winding drum and electric motors with winding control desk. The cages counterbalance each other, one ascending while the other descends. (27) Air ventilating tunnel from upcast shaft. There is an air lock either side of the cage openings of this shaft. (28) Fan house. A huge electric fan draws bad air from the mine. (29) Upcast shaft head gear. (30) Upcast shaft winding house. (31) Boiler house. (32) Power house with air compressors and pumps. Turbo-generators supply electricity to the whole coal mine. (33) Pithead baths and canteen. Each man has a locker for his mining clothes; he can then have a shower and don his ordinary clothes from another locker. (34) Cycle store. (35) Lamp room and First Aid. Each man collects an electric lamp going on duty. They are re-charged between shifts. (36) Entrance to pit. (37) Tub maintenance level. (38) Workshops. (39) Through sidings for stores etc. (40) Loading sidings. These have a slight fall of 1 in 72 to the hoppers. (41) Sidings for stores.

Next week - The story below ground

SECRETS OF THE PANTO

In this special Christmas drawing for EAGLE our artist takes you backstage at the pantomime. He shows you the arrangements for on and off-stage lighting during a performance, the scenic layout, and the operating machinery, which includes a revolving stage. When you visit a pantomime this season you will probably marvel at the wonderful effects you see; this shows you how it is done.

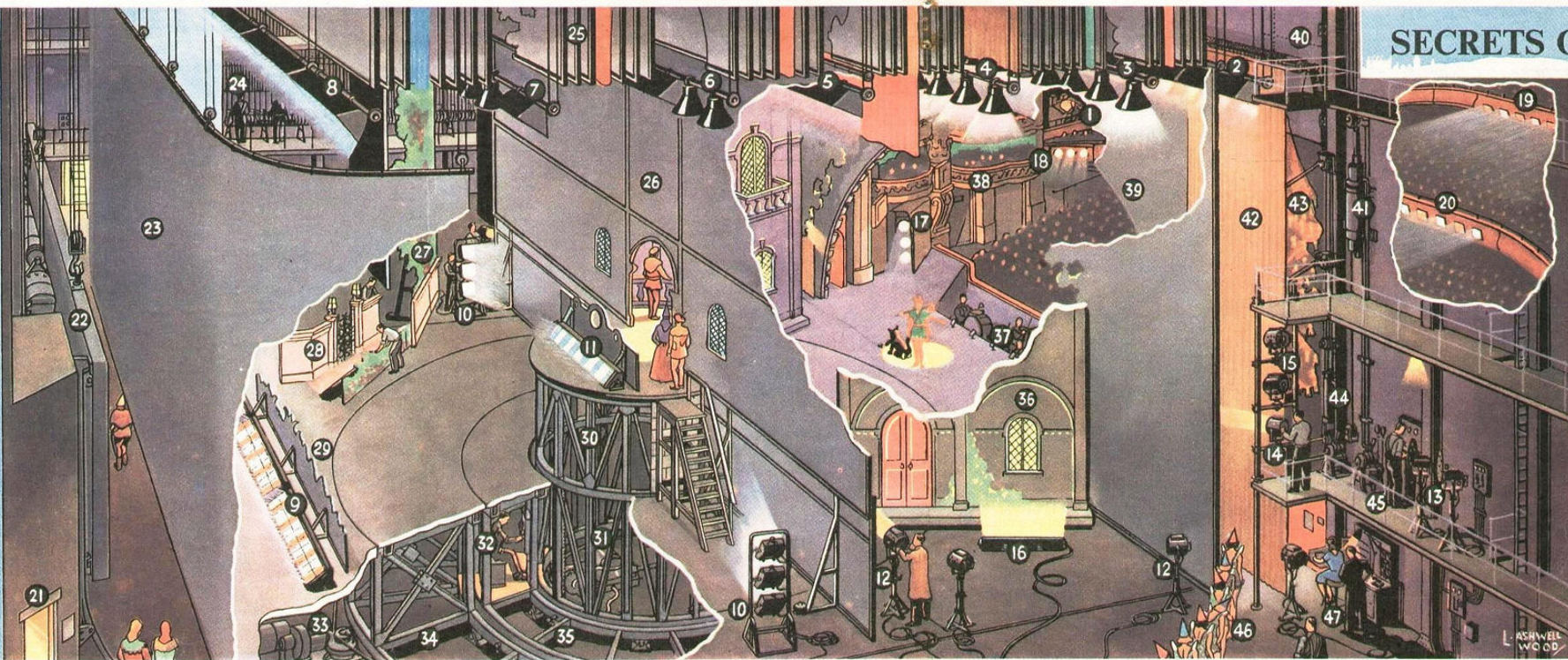
Our illustration represents *The Palladium Theatre, London*, and was drawn with the kind co-operation of Mr Val Parnell. The pantomime is *Dick Whittington*.

KEY TO LIGHTING

(1) Control console, similar to an organ keyboard. From here the electrician controls the entire lighting system for dimming, colour change, etc. The switches and reactors are under the stage floor. (2) Number One 'battern', divided into compartments, each with its own colour screen (1,000-watt lamps). (3) Number One 'acting area' flood lamps. These point vertically downwards on to the actor or group of actors (1,000-watt lamps). (4) Number Two acting area flood lamps. (5) Number Two 'battern'. (6) Number Three 'acting area' flood lamps, composite with 'battern'. (7) Number Four acting area flood lamps 'battern'. (8) Cyclodrama top lighting 'battern'. (9) Cyclodrama bottom lighting floor 'battern'. (10-10) 1,000-watt portable flood lights. (11) Ground row floor 'battern'. (12-12) Portable wing spotlights. (13) 'Effects' spotlights. (14) 'Tracer' spotlights, for following actors across stage. (15) 'Pageant' lights. (16) Ground 'battern' for effects. (17) 2,000-watt automatic colour change spotlights. (18) 'Pageant' lights in front of circle. (19) 10 spotlights in front of upper circle. (20) 16 spotlights in front of circle. All automatic colour change.

KEY TO OTHER PARTS

(21) Entrance from dressing rooms and stage door. (22) 'Band wagon' platform and counter-balance. This slides down and runs horizontally on to stage. Used for bands, etc., going forwards and backwards from front of stage for effect. (23) Cyclodrama background (completely covers back of stage). (24) Winches and counter-balances for the back-drops. (25) Back-drops hanging from gridiron in stage roof. There may be as many as 60 of these in a big production. (26) Back-drop lowered. (27) Scenery 'flat'. (28) New scene being set. (29) Ground row. (30) Lift in centre of revolving stage. This also revolves. (31) Lift machinery. (32) Engineer operating lift and revolving stages; he rotates with the intermediate stage. (33) Stage revolving machinery. (34) Outer revolving stage. All three may be locked as one. (35) Intermediate revolving stage. (36) Double-sided scenery 'flat'. These can be used in combination for different scenes. (37) Stage microphones, nine in all. Centre one raises up. (38) Royal Box. (39) Proscenium opening. (40) Fireproof safety curtain. (41) Hydraulic cylinder operating safety curtain. (42) Hand operated curtain behind proscenium. (43) Main drop curtains in front of proscenium (raised). (44) Hydraulic cylinder operating main drop curtains. (45) 'Flys' or working galleries. (46) Chorus waiting for cue to go on-stage. (47) Prompter and producer. Stage manager's desk is in opposite wing.



The operation of Her Majesty's aircraft and the air travels of the Royal Family are entrusted to the Queen's Flight of the R.A.F. The De Havilland *Heron* Series 2 is the latest addition to the Queen's Flight and is a specially equipped aircraft, replacing one of the four veteran Vickers *Vikings*.

KEY TO PARTS:

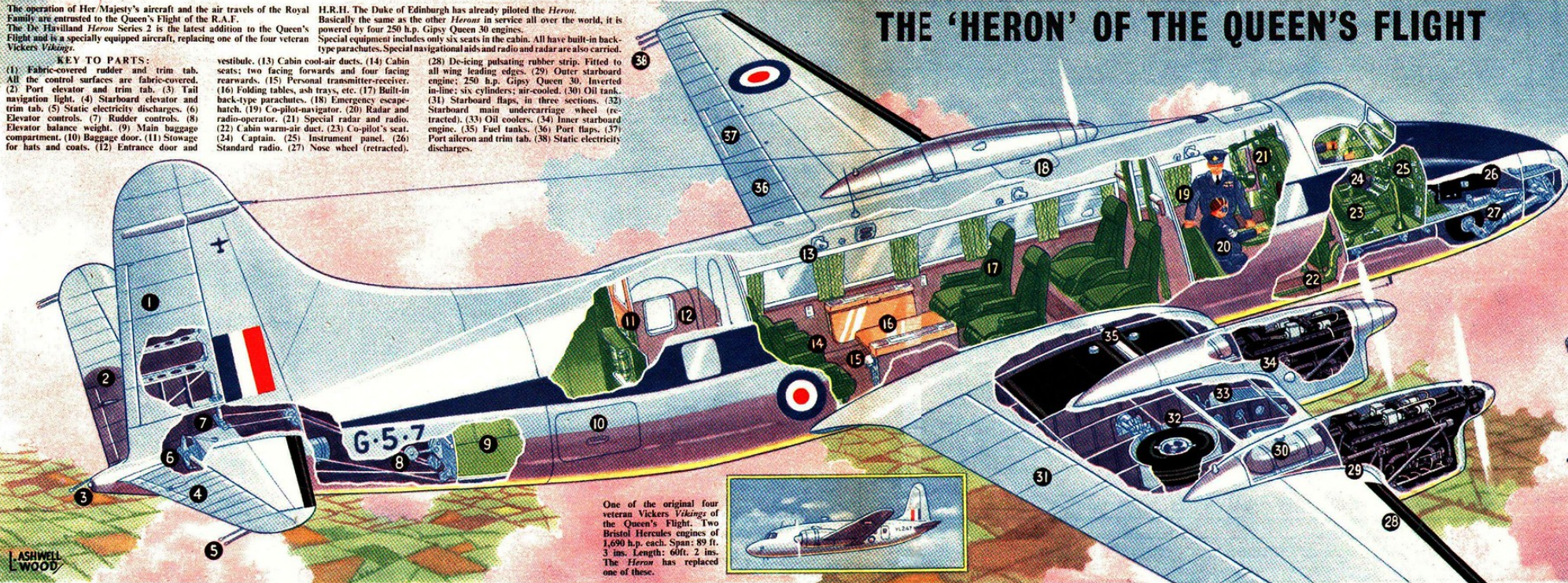
(1) Fabric-covered rudder and trim tab. (2) Port elevator and trim tab. (3) Tail navigation light. (4) Starboard elevator and trim tab. (5) Static electricity discharges. (6) Elevator controls. (7) Rudder controls. (8) Elevator balance weight. (9) Main baggage compartment. (10) Baggage door. (11) Stowage for hats and coats. (12) Entrance door and

vestibule. (13) Cabin cool-air ducts. (14) Cabin seats; two facing forwards and four facing rearwards. (15) Personal transmitter-receiver. (16) Folding tables, ash trays, etc. (17) Built-in back-type parachutes. (18) Emergency escape-hatch. (19) Co-pilot-navigator. (20) Radar and radio-operator. (21) Special radar and radio. (22) Cabin warm-air duct. (23) Co-pilot's seat. (24) Captain. (25) Instrument panel. (26) Standard radio. (27) Nose wheel (retracted).

H.R.H. The Duke of Edinburgh has already piloted the *Heron*. Basically the same as the other *Heron*s in service all over the world, it is powered by four 250 h.p. Gipsy Queen 30 engines. Special equipment includes only six seats in the cabin. All have built-in back-type parachutes. Special navigational aids and radio and radar are also carried.

(28) De-icing pulsating rubber strip. Fitted to all wing leading edges. (29) Outer starboard engine; 250 h.p. Gipsy Queen 30. Inverted in-line; six cylinders; air-cooled. (30) Oil tank. (31) Starboard flaps, in three sections. (32) Starboard main undercarriage wheel (retracted). (33) Oil coolers. (34) Inner starboard engine. (35) Fuel tanks. (36) Port flaps. (37) Port aileron and trim tab. (38) Static electricity discharges.

THE 'HERON' OF THE QUEEN'S FLIGHT



One of the original four veteran Vickers *Vikings* of the Queen's Flight. Two Bristol Hercules engines of 1,690 h.p. each. Span: 89 ft. 3 ins. Length: 60 ft. 2 ins. The *Heron* has replaced one of these.



The De Havilland *Heron* Series 2.
Span: 71 ft. 6 ins.
Length: 48 ft. 6 ins.
Cruising speed: 183 miles per hour.



The Lockheed Constellations, or "Connies" as they are affectionately known, are among the most numerous four engine aircraft in the world. The Trans World Airways alone operate 65 of them, and apart from their world wide routes they do the 2,500 mile transatlantic run West to East in under ten hours at the average of 17 flights a day, cruising at 317 m.p.h. The Constellation is a giant aircraft with its four 18-cylinder 2,500 h.p. Wright Cyclone radial engines, which are equivalent to the power of 400 average motor cars.

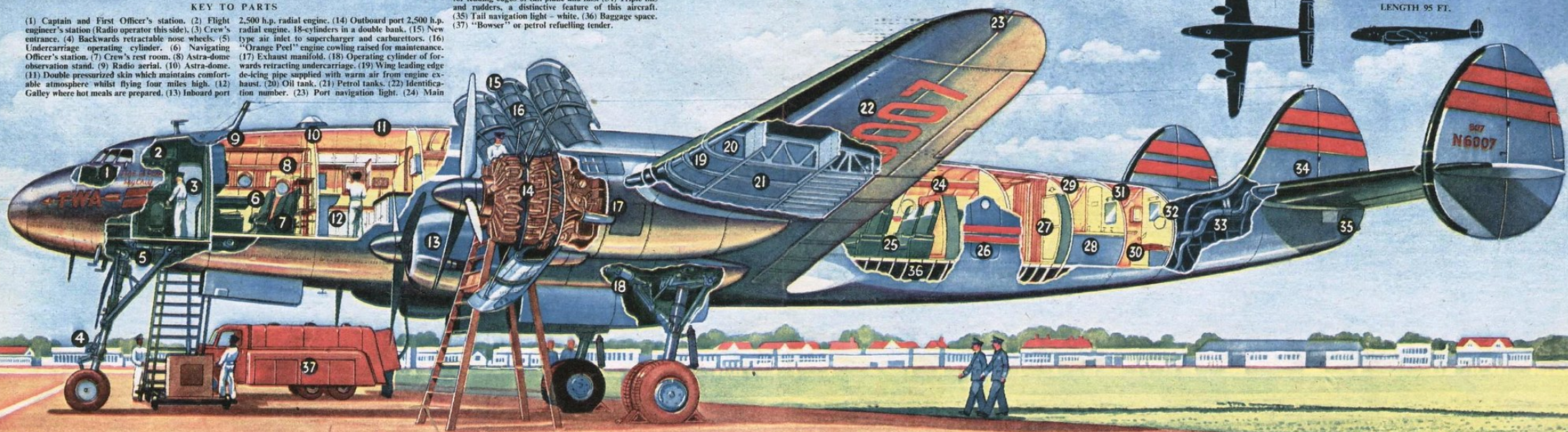
KEY TO PARTS

(1) Captain and First Officer's station. (2) Flight engineer's station (Radio operator this side). (3) Crew's entrance. (4) Backwards retractable nose wheels. (5) Undercarriage operating cylinder. (6) Navigating Officer's station. (7) Crew's rest room. (8) Astra-dome observation stand. (9) Radio aerial. (10) Astra-dome. (11) Double pressurized skin which maintains comfortable atmosphere whilst flying four miles high. (12) Galley where hot meals are prepared. (13) Inboard port 2,500 h.p. radial engine. (14) Outboard port 2,500 h.p. radial engine. 18-cylinders in a double bank. (15) New type air inlet to supercharger and carburetors. (16) "Orange Peel" engine cowlings raised for maintenance. (17) Exhaust manifold. (18) Operating cylinder of forwards retracting undercarriage. (19) Wing leading edge de-icing pipe supplied with warm air from engine exhaust. (20) Oil tank. (21) Petrol tanks. (22) Identification number. (23) Port navigation light. (24) Main

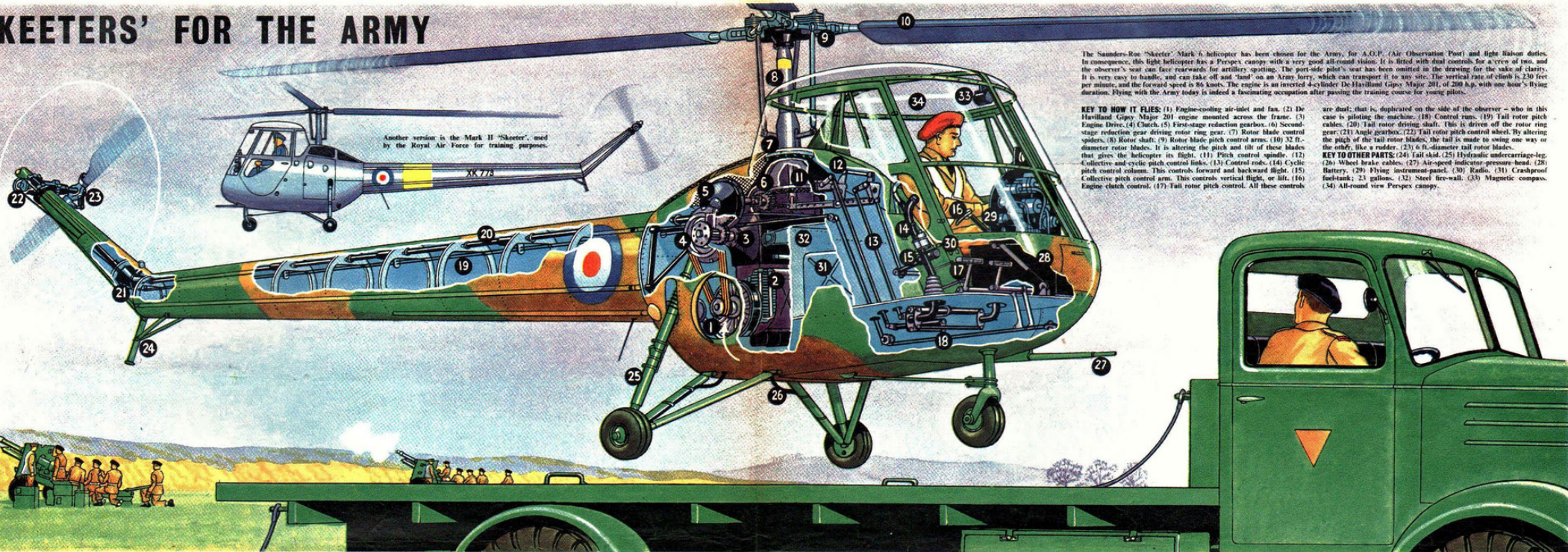
cabin seating 48 passengers. There are various types of accommodation, some being all-sleepers. (25) Sliding tray rests. (26) Passengers' entrance. (27) Ladies' wardrobe. (28) Ladies' lounge and wash. (29) Gentlemen's lounge and wash. (30) Ladies' toilet. (31) Gentlemen's toilet. (32) End of pressurized skin. (33) De-icing pipes for leading edges of tail plane and fins. (34) Triple fins and rudders, a distinctive feature of this aircraft. (35) Tail navigation light - white. (36) Baggage space. (37) "Bowser" or petrol refuelling tender.

A T.W.A. CONSTELLATION SKYLINER

SPAN 123 FT.
LENGTH 95 FT.



'SKEETERS' FOR THE ARMY



Another version is the Mark II "Skeeter", used by the Royal Air Force for training purposes.

The Saunders-Roe "Skeeter" Mark 6 helicopter has been chosen for the Army, for A.G.P. (Air Observation Post) and light liaison duties. In consequence, this light helicopter has a Perspex canopy with a very good all-round vision. It is fitted with dual controls for a crew of two, and the observer's seat can face rearwards for artillery spotting. The port-side pilot's seat has been omitted in the drawing for the sake of clarity. It is very easy to handle, and can take off and 'land' on an Army lorry, which can transport it to any site. The vertical rate of climb is 230 feet per minute, and the forward speed is 86 knots. The engine is an inverted 4-cylinder De Havilland Gipsy Major 201, of 200 h.p. with one hour's flying duration. Flying with the Army today is indeed a fascinating occupation after passing the training course for young pilots.

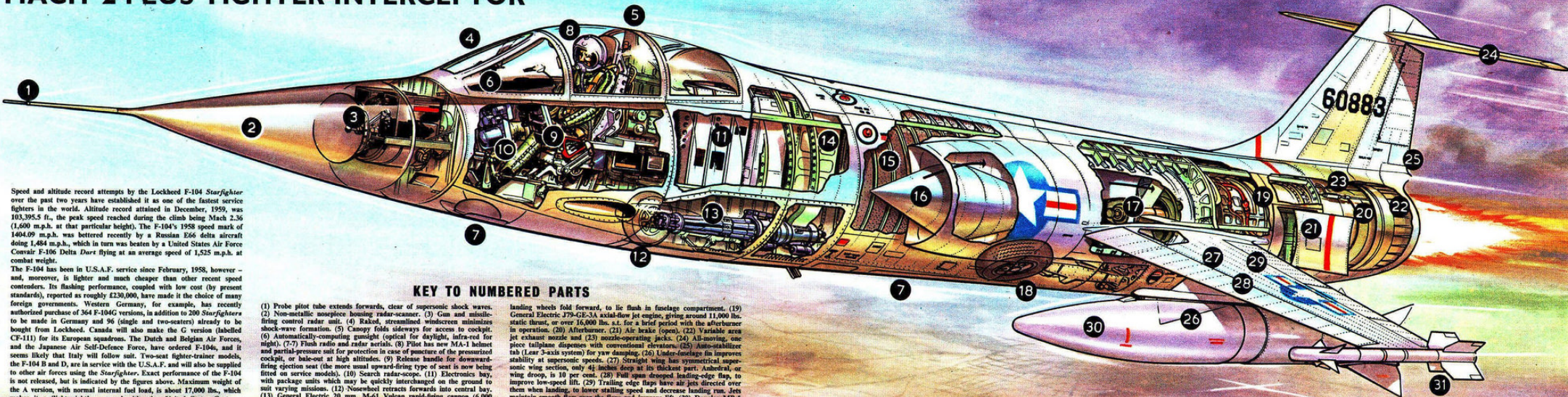
KEY TO HOW IT FLIES: (1) Engine-cooling air-inlet and fan. (2) De Havilland Gipsy Major 201 engine mounted across the frame. (3) Engine Drive. (4) Clutch. (5) First-stage reduction gearbox. (6) Second-stage reduction gear driving rotor ring gear. (7) Rotor blade control spiders. (8) Rotor shaft. (9) Rotor blade pitch control arms. (10) 32 ft. diameter rotor blades. It is altering the pitch and tilt of these blades that gives the helicopter its flight. (11) Pitch control spindle. (12) Collective and cyclic pitch control links. (13) Control rods. (14) Cyclic pitch control column. This controls forward and backward flight. (15) Collective pitch control arm. This controls vertical flight, or lift. (16) Engine clutch control. (17) Tail rotor pitch control. All these controls

are dual; that is, duplicated on the side of the observer - who in this case is piloting the machine. (18) Control runs. (19) Tail rotor pitch gear. (20) Tail rotor driving shaft. This is driven off the rotor ring gear. (21) Angle gearbox. (22) Tail rotor pitch control wheel. By altering the pitch of the tail rotor blades, the tail is made to swing one way or the other, like a rudder. (23) 6 ft. diameter tail rotor blades.

KEY TO OTHER PARTS: (24) Tail skid. (25) Hydraulic undercarriage-leg. (26) Wheel brake cables. (27) Air-speed indicator-pressure head. (28) Battery. (29) Flying instrument-panel. (30) Radio. (31) Crashproof fuel-tank; 23 gallons. (32) Steel fire-wall. (33) Magnetic compass. (34) All-round view Perspex canopy.

LOCKHEED F-104 STARFIGHTER

MACH 2-PLUS FIGHTER-INTERCEPTOR



Speed and altitude record attempts by the Lockheed F-104 *Starfighter* over the past two years have established it as one of the fastest service fighters in the world. Altitude record attained in December, 1959, was 103,395.5 ft., the peak speed reached during the climb being Mach 2.36 (1,600 m.p.h. at that particular height). The F-104's 1958 speed mark of 1404.09 m.p.h. was bettered recently by a Russian E66 delta aircraft doing 1,484 m.p.h., which in turn was beaten by a United States Air Force Convair F-106 Delta *Dart* flying at an average speed of 1,525 m.p.h. at combat weight.

The F-104 has been in U.S.A.F. service since February, 1958, however—and, moreover, is lighter and much cheaper than other recent speed contenders. Its flashing performance, coupled with low cost (by present standards), reported as roughly \$230,000, have made it the choice of many foreign governments. Western Germany, for example, has recently authorized purchase of 364 F-104G versions, in addition to 200 *Starfighters* to be made in Germany and 96 (single and two-seaters) already to be bought from Lockheed. Canada will also make the G version (labelled CF-111) for its European squadrons. The Dutch and Belgian Air Forces, and the Japanese Air Self-Defence Force, have ordered F-104s, and it seems likely that Italy will follow suit. Two-seat fighter-trainer models, the F-104B and D, are in service with the U.S.A.F. and will also be supplied to other air forces using the *Starfighter*. Exact performance of the F-104 is not released, but is indicated by the figures above. Maximum weight of the A version, with normal internal fuel load, is about 17,000 lbs., which makes it a 'lightweight' compared with other United States Century-series fighters. With long-range tip tanks and underwing tanks, the weight rises to 22,000 lbs., ferrying range in this condition being 2,200 miles. Dimensions are: Span, 21 ft. 11 in.; length (without nose probe), 54 ft. 9 in.; height, 13 ft. 6 in.

KEY TO NUMBERED PARTS

(1) Probe pitot tube extends forwards, clear of supersonic shock waves. (2) Non-metallic nosepiece housing radar-scanner. (3) Gun and missile-firing control radar unit. (4) Raked, streamlined windscreen minimizes shock-wave formation. (5) Canopy folds sideways for access to cockpit. (6) Automatically-computing gunsight (optical for daylight, infra-red for night). (7-7) Flush radio and radar aerials. (8) Pilot has new MA-1 helmet and partial-pressure suit for protection in case of puncture of the pressurized cockpit, or bale-out at high altitudes. (9) Release handle for downward-firing ejection seat (the more usual upward-firing type of seat is now being fitted on service models). (10) Search radar-scope. (11) Electronics bay, with package units which may be quickly interchanged on the ground to suit varying missions. (12) Nosewheel retracts forwards into central bay. (13) General Electric 20 mm. M-61 Vulcan rapid-firing cannon (6,000 rounds per minute) has six revolving barrels—a modern version of the old Gatling gun. (14) Gun ammunition tank. (15) Main fuel tanks, fitted around structure to gain maximum capacity. (16) Shock-wave forming wedge prevents congestion of intake, which would cause engine air starvation at supersonic speeds. (17) Air entry into engine compressor. (18) Main

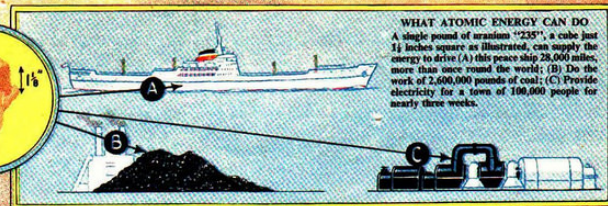
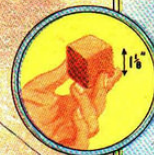
landing wheels fold forward, to lie flush in fuselage compartment. (19) General Electric J79-GE-3A axial-flow jet engine, giving around 11,000 lbs. static thrust, or over 16,000 lbs. s.t. for a brief period with the afterburner in operation. (20) Afterburner. (21) Air brake (open). (22) Variable area jet exhaust nozzle and (23) nozzle-operating jacks. (24) All-moving, one-piece tailplane dispenses with conventional elevators. (25) Auto-stabilizer tab (Lear 3-axis system) for yaw damping. (26) Under-fuselage fin improves stability at supersonic speeds. (27) Straight wing has symmetrical supersonic wing section, only 4½ inches deep at its thickest part. Anhedral, or wing droop, is 10 per cent. (28) Full span drooped leading-edge flap, to improve low-speed lift. (29) Trailing edge flaps have air jets directed over them when landing, to lower stalling speed and decrease landing run. Jets maintain smooth flow over the flaps and improve lift. (30) Douglas MB-1 Genie wing-mounted air-to-air nuclear warhead rocket missile of about 1.5 kilotons yield, with near-miss kill radius of at least a third of a mile. (31) Wingtip-mounted GAR-8 Sidewinder air-to-air guided missiles (one either side) containing normal high-explosive warhead, with proximity fuse and infra-red (heat-seeking) guidance system.

We live in an age of great discoveries. Scientists have not only succeeded in splitting the atom, but also the nucleus of the atom - releasing for human use the vast energy stored up in the heart of matter itself. This great discovery will have a tremendous influence on our lives and the lives of future generations. In order to prepare people for the great benefits which atomic energy makes available to mankind, President Eisenhower, of the United States, plans to send an atomic-powered merchant ship round the world on a peace mission to show all nations the peaceful uses of atomic energy.

ATOMIC PEACE SHIP

This drawing is our artist's impression, based on scientific facts, of what this atomic peace ship will be like - shown here as a cargo-liner. In the meantime, a travelling "Atoms for Peace" exhibition has been opened in London and will move around this summer in turn to Belfast, Glasgow, Newcastle, Edinburgh, Leeds, Liverpool, Manchester, Sheffield, Nottingham, Birmingham, Cardiff, Bristol and Southampton in that order, so look out for this interesting free exhibition.

KEY TO HOW THE ATOMIC-TURBO-ELECTRIC POWER PLANT WORKS: (1) Thick shielding to prevent radiation. (2) Atomic pile or reactor. (3) Tubes with rods of Uranium "235" inside (the fuel). (4) Motor-driven control rods. (5) Liquid metal coolant. This is pumped up through the uranium tubes and carries off the tremendous heat generated there. (6) Hot liquid metal to heat exchanger. (7) Heat exchanger. Here the distilled water from the turbine condensers is immediately turned into steam. (8) Coolant circulating pump. (9) Steam pipe to turbines. (10) High-pressure turbine. (11) Low-pressure turbine. (12) 3,000 volt generator driven by turbines. This supplies current to the propulsion motor. (13) Exhaust steam condenser. Here the exhaust steam is passed round tubes of cold circulating sea-water and is condensed into distilled water. (14) Distilled water pump and pipe to heat exchanger; thus the water and steam go round in a closed circuit. (15) Sea-water circulating pumps. (16) Auxiliary Diesel engine-driven generator. (17) Main control platform. (18) Double unit propulsion motor (forward and reverse) supplied with current from the generators. (19) Propeller shaft and tunnel. (20) Propeller. (21) Rudder. **KEY TO OTHER PARTS:** (22) Steering-gear compartment. (23) Crew's quarters. (24) Fresh-water tanks. (25-26) General cargo. (27) Special cargo of radio-isotopes in protective cases. (28) Back projection exhibition cinema. (29) "Atoms for Peace" exhibition. (30) Ship's stores. (31) Refrigerating machinery. (32) Refrigerated hold. (33) Exhibition buffet. (34) Exhibition annex of atomic appliances. (35-36) General cargo. (37) Passenger accommodation. (38) Cargo-handling derricks. (39) Motor lifeboats. (40) Navigating bridge and wheelhouse. (41) Radar scanner. (42) Streamlined funnel and ventilator air intakes. (43) Hollow mast with look-out position.



WHAT ATOMIC ENERGY CAN DO
A single pound of uranium "235", a cube just 1 1/2 inches square as illustrated, can supply the energy to drive (A) this peace ship 28,000 miles, more than once round the world; (B) Do the work of 2,600,000 pounds of coal; (C) Provide electricity for a town of 100,000 people for nearly three weeks.



WHAT ARE RADIO-ISOTOPES?
Reference is made to a special cargo of radio-isotopes in the peace ship (see No. 27). To-day, nearly any element can be made radio-active by "bombarding" it with uranium "235" in an atomic pile, and the atoms of such elements are called radio-isotopes. These have brought new knowledge to medical and agricultural research, and new methods to industry throughout the world.



THE DIESEL ELECTRIC ICEBREAKER *MACKINAW*

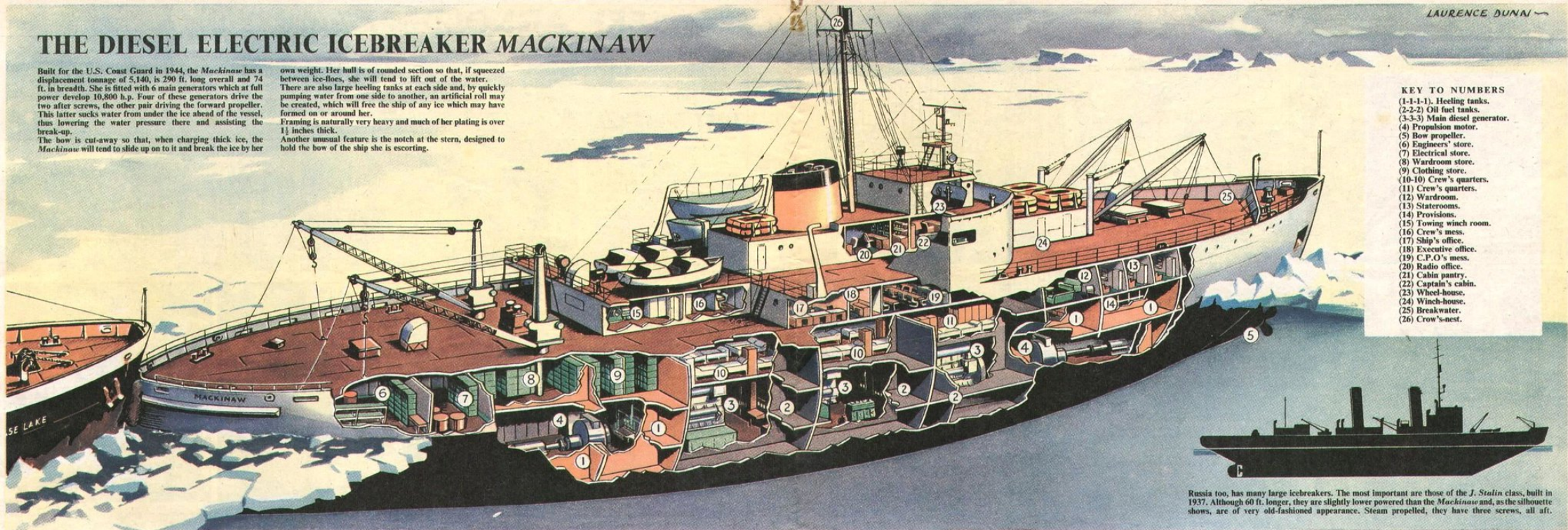
Built for the U.S. Coast Guard in 1944, the *Mackinaw* has a displacement tonnage of 5,140, is 290 ft. long overall and 74 ft. in breadth. She is fitted with 6 main generators which at full power develop 10,800 h.p. Four of these generators drive the two after screws, the other pair driving the forward propeller. This latter sucks water from under the ice ahead of the vessel, thus lowering the water pressure there and assisting the break-up.

The bow is cut-away so that, when charging thick ice, the *Mackinaw* will tend to slide up on to it and break the ice by her

own weight. Her hull is of rounded section so that, if squeezed between ice-floes, she will tend to lift out of the water. There are also large heeling tanks at each side and, by quickly pumping water from one side to another, an artificial roll may be created, which will free the ship of any ice which may have formed on or around her.

Framing is naturally very heavy and much of her plating is over 1½ inches thick.

Another unusual feature is the notch at the stern, designed to hold the bow of the ship she is escorting.



KEY TO NUMBERS

- (1-1-1-1). Heeling tanks.
- (2-2-2) Oil fuel tanks.
- (3-3-3) Main diesel generator.
- (4) Propulsion motor.
- (5) Bow propeller.
- (6) Engineers' store.
- (7) Electrical store.
- (8) Wardroom store.
- (9) Clothing store.
- (10-10) Crew's quarters.
- (11) Crew's quarters.
- (12) Wardroom.
- (13) Staterooms.
- (14) Provisions.
- (15) Towing winch room.
- (16) Crew's mess.
- (17) Ship's office.
- (18) Executive office.
- (19) C.P.O.'s mess.
- (20) Radio office.
- (21) Cabin pantry.
- (22) Captain's cabin.
- (23) Wheel-house.
- (24) Winch-house.
- (25) Breakwater.
- (26) Crew's-nest.

Russia too, has many large icebreakers. The most important are those of the *J. Stalin* class, built in 1937. Although 60 ft. longer, they are slightly lower powered than the *Mackinaw* and, as the silhouette shows, are of very old-fashioned appearance. Steam propelled, they have three screws, all aft.

A GREAT LAKES GRAIN CARRIER

As the fast liners are the greyhounds of the ocean, so these large grain ships are the dachshunds of the Lakes. They ply through the six Great Lakes of North America to the St Lawrence River. The millions of bushels of wheat from the prairies of Canada are collected and stored in huge grain elevators, one of which is shown here. Some of these grain elevators are capable of handling 12,000 tons of grain in one day. From these centres, the grain is carried some 1,000 miles by

the grain ships, through the lakes and canals, to the great export shipping depots. From there it is carried by sea to the flour mills of Great Britain.

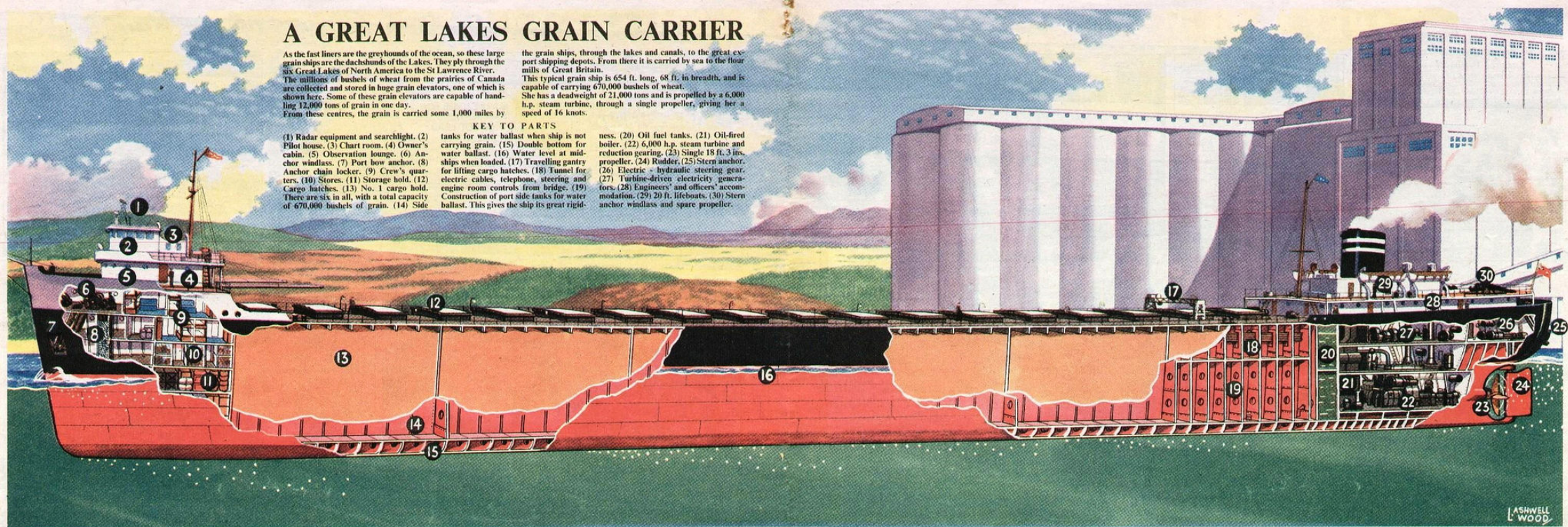
This typical grain ship is 654 ft. long, 68 ft. in breadth, and is capable of carrying 670,000 bushels of wheat. She has a deadweight of 21,000 tons and is propelled by a 6,000 h.p. steam turbine, through a single propeller, giving her a speed of 16 knots.

KEY TO PARTS

(1) Radar equipment and searchlight. (2) Pilot house. (3) Chart room. (4) Owner's cabin. (5) Observation lounge. (6) Anchor windlass. (7) Port bow anchor. (8) Anchor chain locker. (9) Crew's quarters. (10) Stores. (11) Storage hold. (12) Cargo hatches. (13) No. 1 cargo hold. There are six in all, with a total capacity of 670,000 bushels of grain. (14) Side

tanks for water ballast when ship is not carrying grain. (15) Double bottom for water ballast. (16) Water level at midships when loaded. (17) Travelling gantry for lifting cargo hatches. (18) Tunnel for electric cables, telephone, steering and engine room controls from bridge. (19) Construction of port side tanks for water ballast. This gives the ship its great rigid-

ness. (20) Oil fuel tanks. (21) Oil-fired boiler. (22) 6,000 h.p. steam turbine and reduction gearing. (23) Single 15 ft. 3 ins. propeller. (24) Rudder. (25) Stern anchor. (26) Electric-hydraulic steering gear. (27) Turbine-driven electricity generators. (28) Engineers' and officers' accommodation. (29) 20 ft. lifeboats. (30) Stern anchor windlass and spare propeller.



A HYDROGEN-PEROXIDE-DRIVEN SUBMARINE



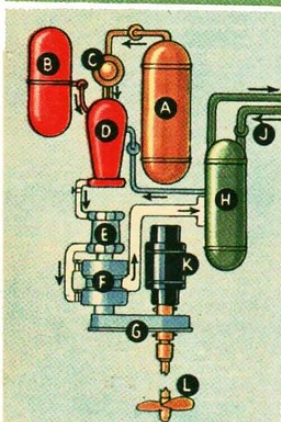
Normally a submarine can only use her Diesel engines on the surface, at 18 knots, and charge her batteries for the electric motors, used when submerged at 10 knots.



With the use of the "Snort" breathing tube, a submarine can use her Diesel engines when submerged, but only at periscope depth: speed 14 knots.



With the closed-circuit hydrogen peroxide system, a submarine can dive quickly and cruise submerged at 25 knots, and charge her batteries.



LAY-OUT OF A CLOSED CIRCUIT, HYDROGEN PEROXIDE PROPULSION SYSTEM IN SIMPLIFIED FORM (STARBOARD UNIT)

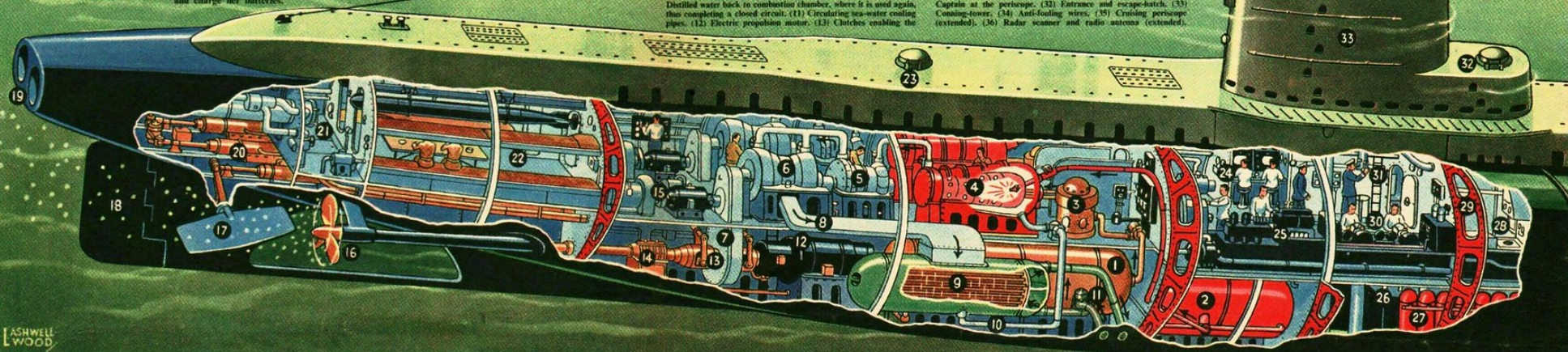
(A) Hydrogen peroxide tank (H_2O_2). (B) Diesel-oil tank. (C) Catalyst. This is an agent that produces chemical reaction in others, while remaining unchanged itself. (D) Combustion chamber. (E) High-pressure ahead steam turbine. (F) Low-pressure ahead and astern steam turbine. (G) Reduction gearing. (H) Condenser. (J) Circulating sea-water cooling pipes. (K) Electric propulsion motor. (L) Propeller shaft and propeller.

A revolutionary design of submarine has been built for the Royal Navy, using a closed-circuit, high-test hydrogen peroxide propulsion system. This chemical combination, in conjunction with the ordinary electric motors, will boost the underwater speed to about 25 knots, compared with the 8 to 10 knots of the ordinary type submarine.

This system also does away with the use of the "Snort" breathing tube, and allows the submarine to remain submerged for long periods. The hydrogen peroxide (H_2O_2) is contained in large tanks. The British submarine system is a closely guarded secret, but this drawing only shows our artist's impression of such a system, based on scientific facts.

KEY TO THE STARBOARD PROPULSION SYSTEM: (1) Hydrogen peroxide tank (H_2O_2). (2) Diesel-oil tank. (3) Catalyst reactor. The hydrogen peroxide is pumped through this, and is changed into free oxygen and hydrogen gas. (4) Combustion chamber, where the gases are mixed with ignited Diesel oil; steam and gas is produced at high temperature. This is cooled down by distilled water and passes to the steam turbines. (5) High-pressure ahead steam turbine. (6) Low-pressure ahead and astern steam turbines. (7) Reduction gearing, driving propeller shaft. (8) Exhaust steam and gases to condenser. (9) Condenser, where the exhaust steam is condensed into distilled water by the cooling action of circulating sea-water. (10) Distilled water back to combustion chamber, where it is used again, thus completing a closed circuit. (11) Circulating sea-water cooling pipes. (12) Electric propulsion motor. (13) Clutches enabling the

steam turbine drive to be used independently or in conjunction with the electric motor for high underwater speed. (14) Propeller shaft thrust block. (15) Auxiliary generators and chemical oxygen producer. (16) Starboard propeller. **KEY TO OTHER PARTS:** (17) Stern torpedo-tubes. (18) Hydroplane and rudder hydraulic rams. (19) Stern torpedo-room. (20) Stern crew's quarters and mess. (21) After escape-hatch. (22) Radar room. (23) Diving controls. (24) Batteries for electric propulsion motors. (25) Compressed-air bottles for blowing tanks when surfacing. (26) Galley. (27) Section of outer hull tanks. (28) Hydroplane controls. (29) Control-room, with Captain at the periscope. (30) Entrance and escape-hatch. (31) Conning-tower. (32) Anti-fouling wires. (33) Cruising periscope (extended). (34) Radar scanner and radio antenna (extended).



LASHWELL
WOOD

THE NEW "ELIZABETHAN" AIR-LINER

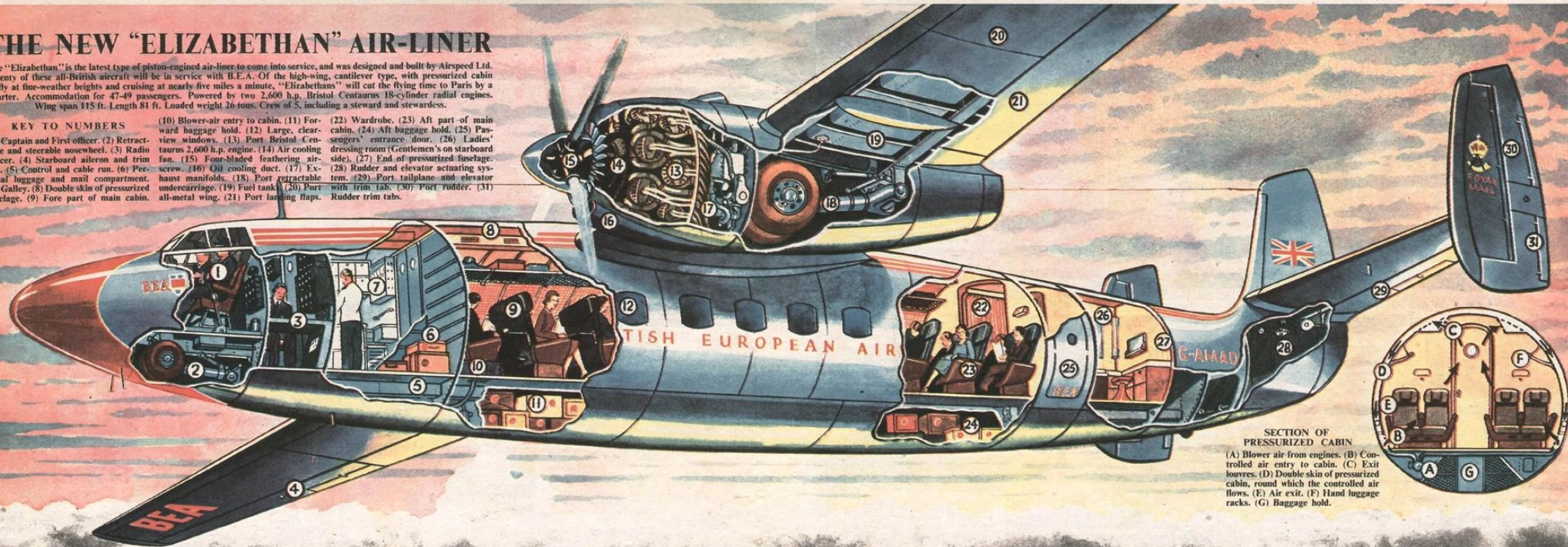
The "Elizabethan" is the latest type of piston-engine air-liner to come into service, and was designed and built by Airspeed Ltd. Twenty of these all-British aircraft will be in service with B.E.A. Of the high-wing, cantilever type, with pressurized cabin to fly at fine-weather heights and cruising at nearly five miles a minute. "Elizabethans" will cut the flying time to Paris by a quarter. Accommodation for 47-49 passengers. Powered by two 2,600 h.p. Bristol Centaurus 18-cylinder radial engines. Wing span 115 ft. Length 81 ft. Loaded weight 26 tons. Crew of 5, including a steward and stewardess.

KEY TO NUMBERS

(1) Captain and First officer. (2) Retractable and steerable nosewheel. (3) Radio officer. (4) Starboard aileron and trim tab. (5) Control and cable run. (6) Personal luggage and mail compartment. (7) Galley. (8) Double skin of pressurized fuselage. (9) Fore part of main cabin.

(10) Blower-air entry to cabin. (11) Forward baggage hold. (12) Large, clear-view windows. (13) Port Bristol Centaurus 2,600 h.p. engine. (14) Air cooling fan. (15) Four-bladed feathering air-screw. (16) Oil cooling duct. (17) Exhaust manifolds. (18) Port retractable undercarriage. (19) Fuel tank. (20) Port all-metal wing. (21) Port landing flaps.

(22) Wardrobe. (23) Aft part of main cabin. (24) Aft baggage hold. (25) Passengers' entrance door. (26) Ladies' dressing room (Gentlemen's on starboard side). (27) End of pressurized fuselage. (28) Rudder and elevator actuating system. (29) Port tailplane and elevator with trim tab. (30) Port rudder. (31) Rudder trim tabs.



SECTION OF PRESSURIZED CABIN

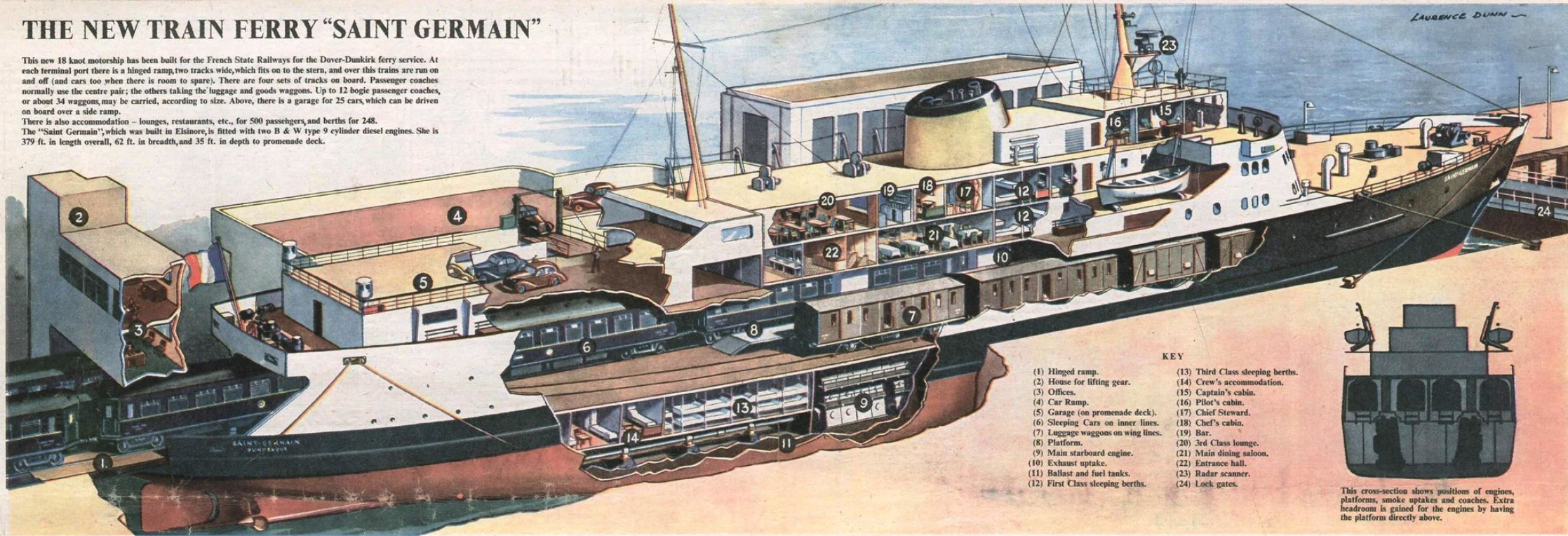
(A) Blower air from engines. (B) Controlled air entry to cabin. (C) Exit louvres. (D) Double skin of pressurized cabin, round which the controlled air flows. (E) Air exit. (F) Hand luggage racks. (G) Baggage hold.

LAURENCE DUNN

THE NEW TRAIN FERRY "SAINT GERMAIN"

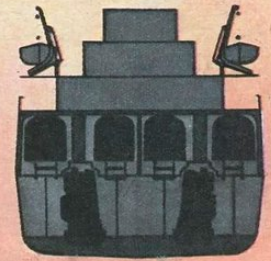
This new 18 knot motorship has been built for the French State Railways for the Dover-Dunkirk ferry service. At each terminal port there is a hinged ramp, two tracks wide, which fits on to the stern, and over this trains are run on and off (and cars too when there is room to spare). There are four sets of tracks on board. Passenger coaches normally use the centre pair; the others taking the luggage and goods waggons. Up to 12 bogie passenger coaches, or about 34 waggons, may be carried, according to size. Above, there is a garage for 25 cars, which can be driven on board over a side ramp.

There is also accommodation - lounges, restaurants, etc., for 500 passengers, and berths for 248. The "Saint Germain", which was built in Elsinore, is fitted with two B & W type 9 cylinder diesel engines. She is 379 ft. in length overall, 62 ft. in breadth, and 35 ft. in depth to promenade deck.



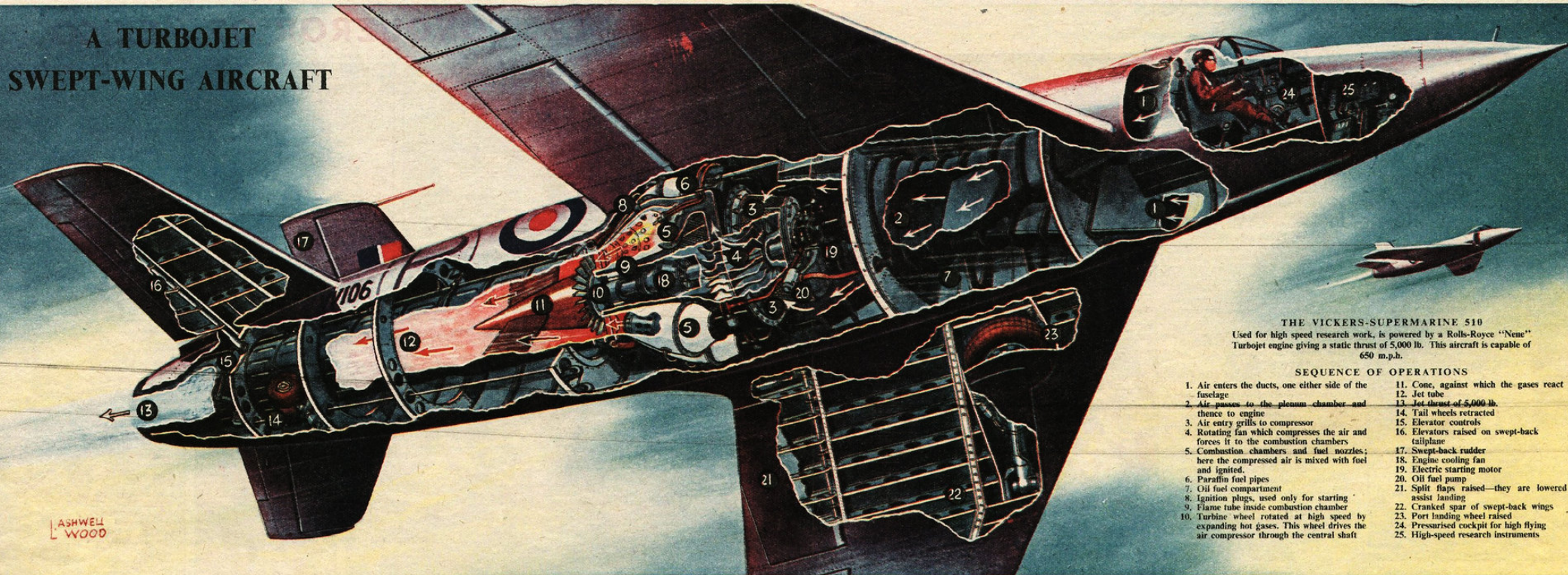
KEY

- | | |
|------------------------------------|-----------------------------------|
| (1) Hinged ramp. | (13) Third Class sleeping berths. |
| (2) House for lifting gear. | (14) Crew's accommodation. |
| (3) Offices. | (15) Captain's cabin. |
| (4) Car Ramp. | (16) Pilot's cabin. |
| (5) Garage (on promenade deck). | (17) Chief Steward. |
| (6) Sleeping Cars on inner lines. | (18) Chef's cabin. |
| (7) Luggage waggons on wing lines. | (19) Bar. |
| (8) Platform. | (20) 3rd Class lounge. |
| (9) Main starboard engine. | (21) Main dining saloon. |
| (10) Exhaust uptake. | (22) Entrance hall. |
| (11) Ballast and fuel tanks. | (23) Radar scanner. |
| (12) First Class sleeping berths. | (24) Lock gates. |



This cross-section shows positions of engines, platforms, smoke uptakes and coaches. Extra headroom is gained for the engines by having the platform directly above.

A TURBOJET SWEPT-WING AIRCRAFT



THE VICKERS-SUPERMARINE 510

Used for high speed research work, is powered by a Rolls-Royce "Nene" Turbojet engine giving a static thrust of 5,000 lb. This aircraft is capable of 650 m.p.h.

SEQUENCE OF OPERATIONS

1. Air enters the ducts, one either side of the fuselage
2. Air passes to the plenum chamber and thence to engine
3. Air entry grills to compressor
4. Rotating fan which compresses the air and forces it to the combustion chambers
5. Combustion chambers and fuel nozzles; here the compressed air is mixed with fuel and ignited.
6. Paraffin fuel pipes
7. Oil fuel compartment
8. Ignition plugs, used only for starting
9. Flame tube inside combustion chamber
10. Turbine wheel rotated at high speed by expanding hot gases. This wheel drives the air compressor through the central shaft
11. Cone, against which the gases react
12. Jet tube
13. Jet thrust of 5,000 lb.
14. Tail wheels retracted
15. Elevator controls
16. Elevators raised on swept-back tailplane
17. Swept-back rudder
18. Engine cooling fan
19. Electric starting motor
20. Oil fuel pump
21. Split flaps raised—they are lowered to assist landing
22. Cranked spar of swept-back wings
23. Port landing wheel raised
24. Pressurised cockpit for high flying
25. High-speed research instruments

A DOUBLE TWIN JET RESEARCH BOMBER

Known as the Short *Sherrin*, these bombers are of unusual design in having two sets of Rolls-Royce Avon R.A.3 jet engines placed one above the other on each wing. They are not in operational service, but are used for high-altitude, high-speed research, bomb-practice and preliminary training of crews for Britain's new V-Bombers. A crew of five is carried in a special pressurized cabin, which has a bomb-aimer's tunnel forward and an entry and escape tunnel below.

Braking-parachutes are carried in the tail and, when released, pull the aircraft back when landing on short runways.

Length: 102 ft. Span: 109 ft.

KEY TO PORT JET ENGINES

(1) Air entry ducts. (2) Air compressor (lower port engine). (3) Combustion chambers. (4) Turbine casing. (5) Jet tube. (6) Jet exhaust. (7) Upper port engine.

KEY TO OTHER PARTS

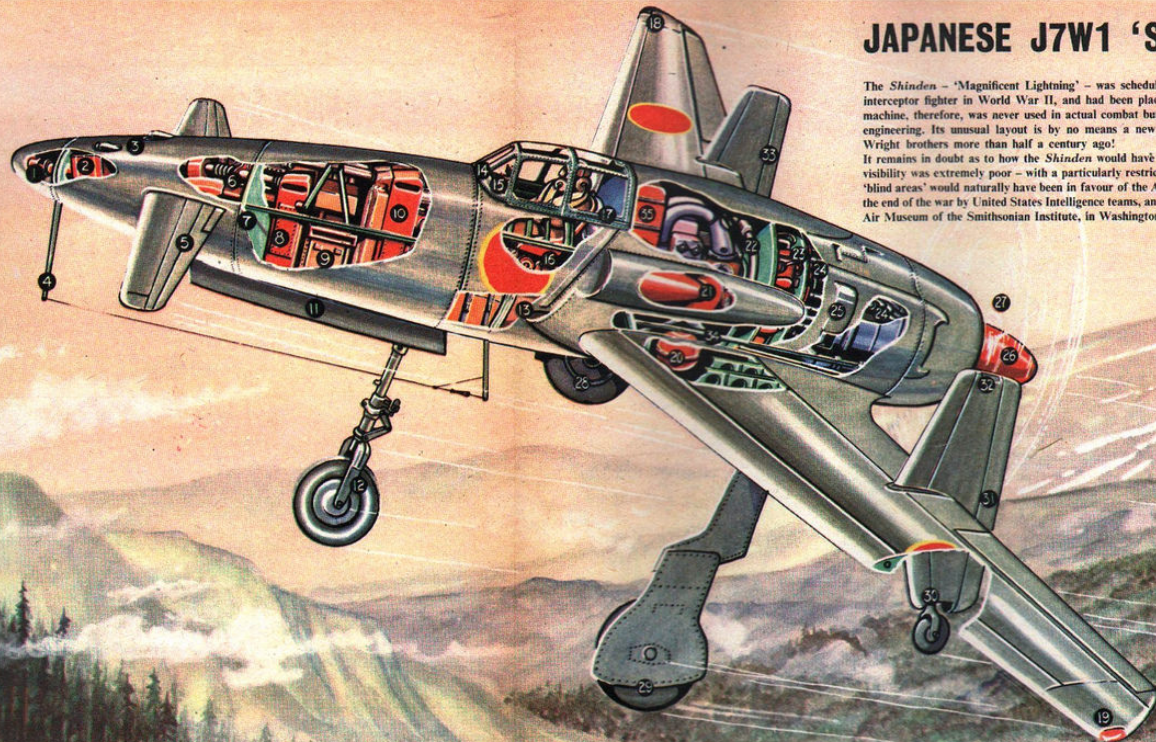
(8) Bomb-aimer's window. (9) Cool-air vent. (10) Bomb-aimer's tunnel. (11) Radome. (12) Pressurized cabin. (13) Pilot and co-pilot. (14) Control panel. (15) Wireless operator's, navigator's (centre) and bomb-aimer's seats. (16) Sealed entrance and exit door. (17) Rescue dinghy (stowed). (18) Fuselage fuel tanks. (19) Oxygen bottles. (20) Steerable nosewheels retracting rearwards. (21) Entry and escape hatch. (22) Starboard jet engines. (23) Starboard undercarriage wheels retracting inwards. (24) Bomb-bay doors. (25) Port undercarriage door (down). (26) Port undercarriage wheels retracting inwards. (27) Port inner wing flap. (28) Camera. (29) Maintenance hatch. (30) Control cable runs. (31) Rudder and elevator servo-tab controls. (32) Braking parachute (stowed). (33) Port elevator servo-tab. When these tabs are moved, they operate the main control surfaces in each case; i.e., elevators, rudder and ailerons. (34) Rudder servo-tab. (35) Port air-brake flap and outer wing flap. (36) Port aileron servo-tab. (37) Port landing light. (38) 16 m.m. cine-camera aperture. (39) Air pressure head.

Sequence of operations of braking parachute. (A) Opening parachute is released first - this pulls out (B), the retarding parachute - which gently pulls out (C), the main braking parachutes.



KEY TO NUMBERS

(1) Cine-camera housing. (2) Battery. (3) Muzzles of upper and lower Port 30 m.m. cannon. (4) Radio antenna. (5) Split elevator. (6) 30 m.m. cannon. There are four of these – two Port and two Starboard. (7) Armour bulkhead, 16 m.m. thick. (8) Ammunition tank for lower port 30 m.m. cannon; capacity, 120 rounds. (9) Shell-case collector-box. (10) Ammunition tank for upper Port 30 m.m. cannon. (11) Nosewheel-housing door. (12) Nosewheel member (retractable). (13) Fuel tank; capacity, 88 Imperial gallons. (14) Bullet-proof windscreen. (15) Reflector gun-sight. (16) Pilot's seat. (17) Oxygen bottles. (18) Starboard wingtip navigation light. (19) Port wingtip navigation light. (20) Compressed-air bottle. (21) Intake for turbo-supercharger. (22) Main engine mount. (23) Eighteen-cylinder air-cooled Mitsubishi Ha-43-42 radial engine, developing 2,130 h.p. (24) Exhaust collectors. (25) Coolant air intake. (26) Spinner. (27) Six-blade constant-speed airscrew. (28) Starboard mainwheel. (29) Port mainwheel. The main undercarriage members fold inwards and retract into flush wing-wells. (30) Auxiliary wheels, fitted at the base of each fin to safeguard against tail-down landing. (31) Port fin and rudder. (32) Mass balances. (33) Starboard fin and rudder. (34) Engine bearer. (35) Oil tank; capacity, 35.2 Imperial gallons.



JAPANESE J7W1 'SHINDEN' TAIL-FIRST FIGHTER

The *Shinden* – 'Magnificent Lightning' – was scheduled to serve in the Japanese Naval Air Force as a short-range interceptor fighter in World War II, and had been placed in quantity production when Japan capitulated. This unique machine, therefore, was never used in actual combat but does, however, remain an outstanding example of aeronautical engineering. Its unusual layout is by no means a new idea. Known as the 'canard' configuration, it was used by the Wright brothers more than half a century ago!

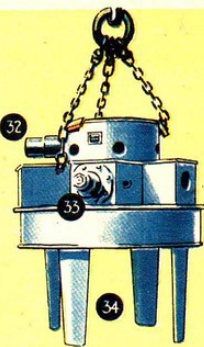
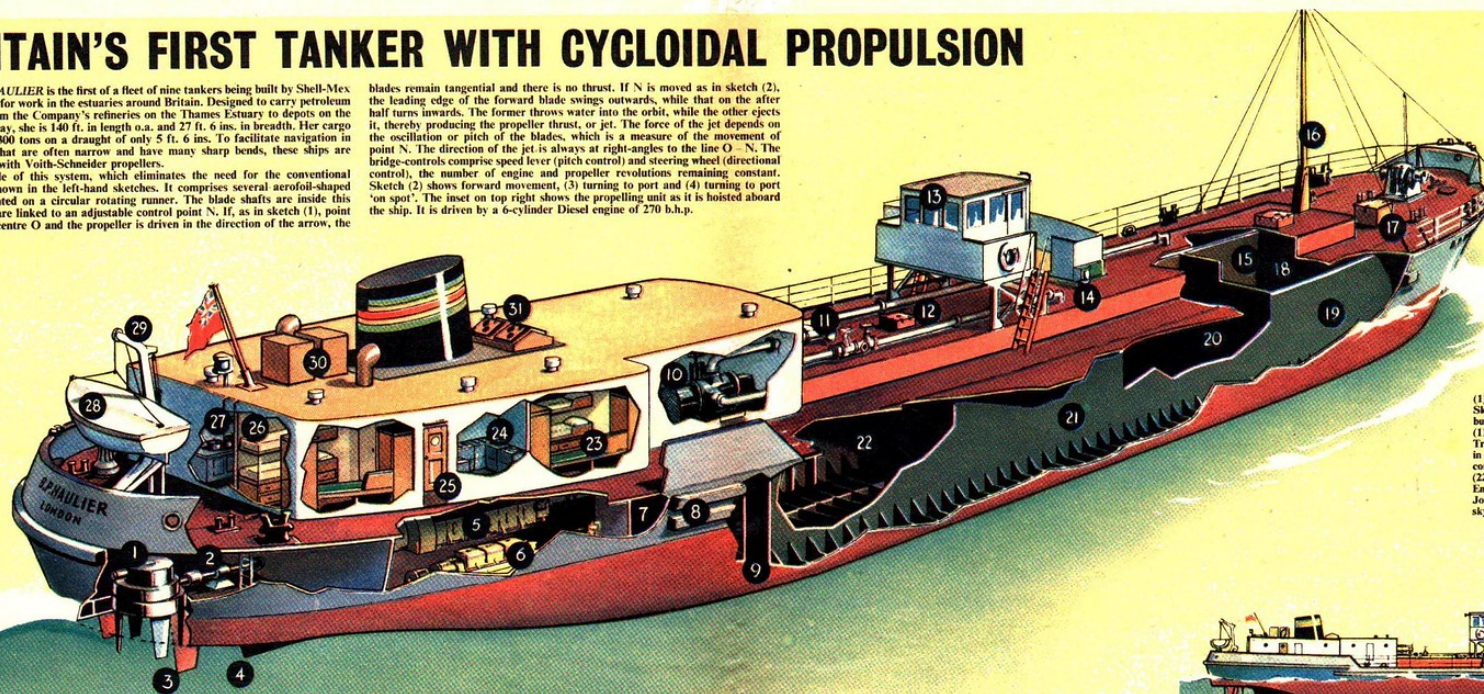
It remains in doubt as to how the *Shinden* would have fared against Allied fighters in aerial combat, because its pilot visibility was extremely poor – with a particularly restricted rearward vision – as a study of our drawing will show. Such 'blind areas' would naturally have been in favour of the Allied aircraft. The prototype *Shinden* was discovered soon after the end of the war by United States Intelligence teams, and was shipped to the U.S.A. Later, it was donated to the National Air Museum of the Smithsonian Institute, in Washington, where eventually it is due to be displayed.

BRITAIN'S FIRST TANKER WITH CYCLOIDAL PROPULSION

The B.P. HAULIER is the first of a fleet of nine tankers being built by Shell-Mex & B.P. Ltd. for work in the estuaries around Britain. Designed to carry petroleum products from the Company's refineries on the Thames Estuary to depots on the River Medway, she is 140 ft. in length o.a. and 27 ft. 6 ins. in breadth. Her cargo capacity is 300 tons on a draught of only 5 ft. 6 ins. To facilitate navigation in waterways that are often narrow and have many sharp bends, these ships are being fitted with Voith-Schneider propellers.

The principle of this system, which eliminates the need for the conventional rudder, is shown in the left-hand sketches. It comprises several aerofoil-shaped blades mounted on a circular rotating runner. The blade shafts are inside this runner and are linked to an adjustable control point N. If, as in sketch (1), point N is at the centre O and the propeller is driven in the direction of the arrow, the

blades remain tangential and there is no thrust. If N is moved as in sketch (2), the leading edge of the forward blade swings outwards, while that on the after half turns inwards. The former throws water into the orbit, while the other ejects it, thereby producing the propeller thrust, or jet. The force of the jet depends on the oscillation or pitch of the blades, which is a measure of the movement of point N. The direction of the jet is always at right-angles to the line O - N. The bridge-controls comprise speed lever (pitch control) and steering wheel (directional control), the number of engine and propeller revolutions remaining constant. Sketch (2) shows forward movement, (3) turning to port and (4) turning to port 'on spot'. The inset on top right shows the propelling unit as it is hoisted aboard the ship. It is driven by a 6-cylinder Diesel engine of 270 b.h.p.



KEY TO SECTIONAL DRAWING OF B.P. HAULIER

(1) Voith-Schneider propelling unit. (2) Shaft. (3) Twin propeller guards. (4) Skag. (5) 270 b.h.p. propelling motor. (6) Auxiliary machinery. (7) Oil bunker space. (8) Rubbing strakes. (9) Cofferdam. (10) Cargo pump room. (11) Cargo pipe-lines. (12) Tank hatch. (13) Collapsible wheelhouse. (14) Trunk deck. (15) Centreline bulkhead (perforated at base). (16) Hinged mast in tabernacle. (17) Hatch to store. (18) No. 1 spirit tank. (19) Dry wing compartment. (20) No. 2 spirit tank. (21) Spirit-tight longitudinal bulkhead. (22) No. 4 spirit tank. (23) Cabin for two seamen. (24) Battery room. (25) Entrance to accommodation. (26) Cabin for two seamen. (27) Galley. (28) Jolly boat. (29) Single Schat-type davit. (30) Water tanks. (31) Engine-room skylight. (32) Servomotor. (33) Driving shaft. (34) Four propeller blades.



LAURENCE DUNN

COMMANDO AIRCRAFT CARRIER

H.M.S. *Bulwark*, the Royal Navy's first Commando carrier, has a complement of 600 officers and men of the 42 Commando, Royal Marines, in addition to a crew of 1,037.

She carries 16 Westland Whirlwind helicopters stowed in two below-deck hangars - fore and aft. These helicopters form a fast-striking force capable of taking off within seconds of the word 'go', loaded with armed commandos or equipment, and landing them in a trouble spot many miles away ready for immediate action. Four assault landing craft can also be launched for landing heavy trucks, etc.

The original H.M.S. *Bulwark* had an extensive refit to carry out her new role. Her steam turbines develop 78,000 h.p., giving a speed of 28 knots.



Royal Navy Westland Whirlwind Helicopter

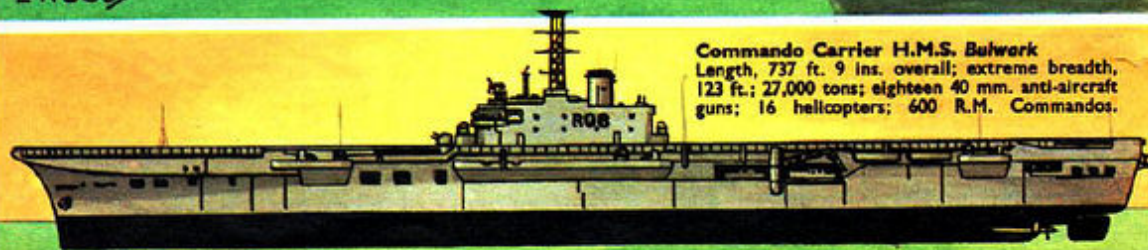
(A) Alvis Leonides Major radial engine. (B) Cabin for ten armed Royal Marine Commandos. (C) Driving shaft to rotor. (D) Rotor gearbox. (E) Driving shaft for tail rotor. (F) Rotor lead with variable-pitch blades. (G) Tail rotor drive coupling. (H) Tail rotor.



KEY TO NUMBERED PARTS

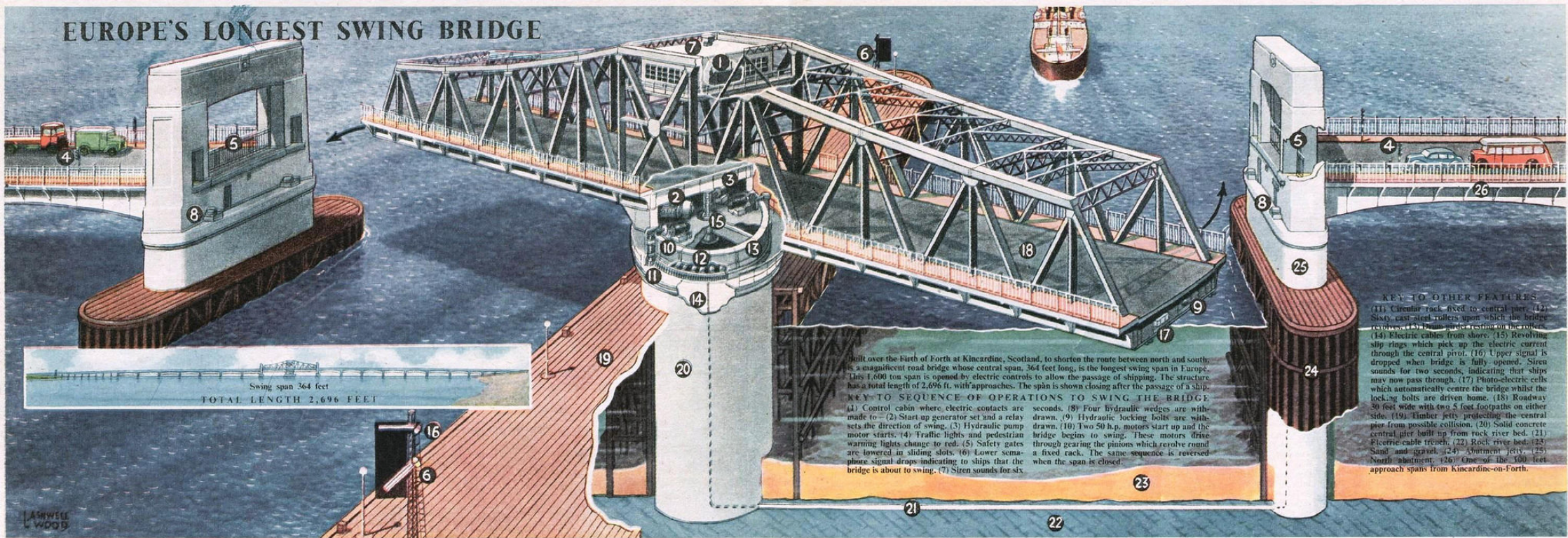
(1) Forward stores. (2) Crew's wash space. (3) Aviation fuel tanks. (4) Crew's dining space. (5) Commandos' dining space. (6) Petty Officers' dining space. (7) Recreation room. (8) Commandos' gallery, from which they board the forward helicopters. (9) Air-conditioning machinery. (10) Machine shops. (11) Metal-workers' shop. (12) Aero engine room. (13) Stores. (14) Helicopter deck positions - 9 in all. (15) No. 1 Westland Whirlwind helicopter ready for loading. (16) 40 mm. anti-aircraft guns. (17) Aerial mast, lowered during flying. (18) Forward aircraft lift. (19) Forward hangar for eight helicopters. (20) 40 mm. anti-aircraft guns and fire director. (21) 6-barrelled multiple anti-aircraft guns and fire director. (22) Assault landing craft, port and starboard. (23) Navigating bridge. (24) 40 mm. anti-aircraft guns. (25) Upper bridges. (26) Aft aircraft lift to hangar for eight helicopters. (27) Nos. 4-5-6 helicopter positions. (28) Commando landing vehicles and equipment. (29) Direction finding radio and radar. (30) Lattice mast. (31) Radar scanners.

ASHWELL
L'WOOD



Commando Carrier H.M.S. *Bulwark*
Length, 737 ft. 9 ins. overall; extreme breadth, 123 ft.; 27,000 tons; eighteen 40 mm. anti-aircraft guns; 16 helicopters; 600 R.M. Commandos.

EUROPE'S LONGEST SWING BRIDGE



Built over the Firth of Forth at Kincardine, Scotland, to shorten the route between north and south, is a magnificent road bridge whose central span, 364 feet long, is the longest swing span in Europe. This 1,600 ton span is opened by electric controls to allow the passage of shipping. The structure has a total length of 2,696 ft. with approaches. The span is shown closing after the passage of a ship.

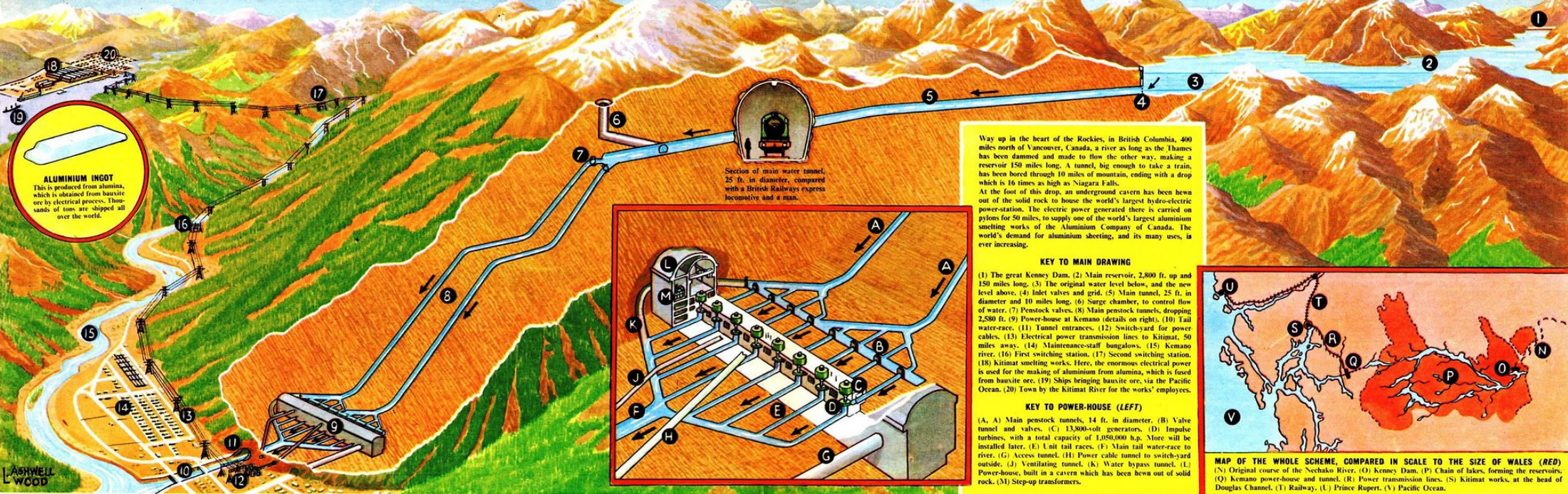
KEY TO SEQUENCE OF OPERATIONS TO SWING THE BRIDGE

(1) Control cabin where electric contacts are made to— (2) Start up generator set and a relay sets the direction of swing. (3) Hydraulic pump motor starts. (4) Traffic lights and pedestrian warning lights change to red. (5) Safety gates are lowered in sliding slots. (6) Lower semaphore signal drops indicating to ships that the bridge is about to swing. (7) Siren sounds for six seconds. (8) Four hydraulic wedges are withdrawn. (9) Hydraulic locking bolts are withdrawn. (10) Two 50 h.p. motors start up and the bridge begins to swing. These motors drive through gearing the pinions which revolve round a fixed rack. The same sequence is reversed when the span is closed.

KEY TO OTHER FEATURES

(11) Circular rock fixed to central pier. (12) Sixty cast steel rollers upon which the bridge revolves. (13) Drum-pulley resting on the rollers. (14) Electric cables from shore. (15) Revolving slip rings which pick up the electric current through the central pivot. (16) Upper signal is dropped when bridge is fully opened. Siren sounds for two seconds, indicating that ships may now pass through. (17) Photo-electric cells which automatically centre the bridge whilst the locking bolts are driven home. (18) Roadway 30 feet wide with two 5 feet footpaths on either side. (19) Timber jetty protecting the central pier from possible collision. (20) Solid concrete central pier built up from rock river bed. (21) Electric cable trench. (22) Rock river bed. (23) Sand and gravel. (24) Abutment jetty. (25) North abutment. (26) One of the 100 feet approach spans from Kincardine-on-Forth.

WORLD'S MIGHTIEST POWER SCHEME



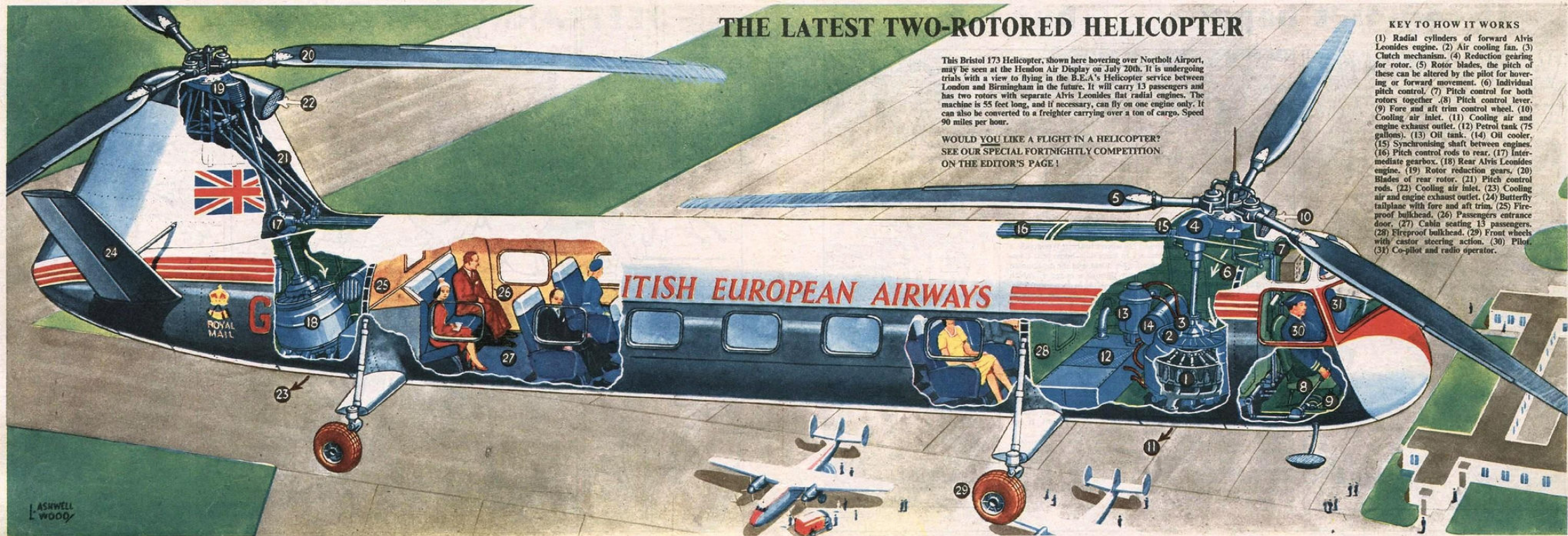
THE LATEST TWO-ROTORED HELICOPTER

This Bristol 173 Helicopter, shown here hovering over Northolt Airport, may be seen at the Hendon Air Display on July 20th. It is undergoing trials with a view to flying in the B.E.A.'s Helicopter service between London and Birmingham in the future. It will carry 13 passengers and has two rotors with separate Alvis Leonides flat radial engines. The machine is 55 feet long, and if necessary, can fly on one engine only. It can also be converted to a freighter carrying over a ton of cargo. Speed 90 miles per hour.

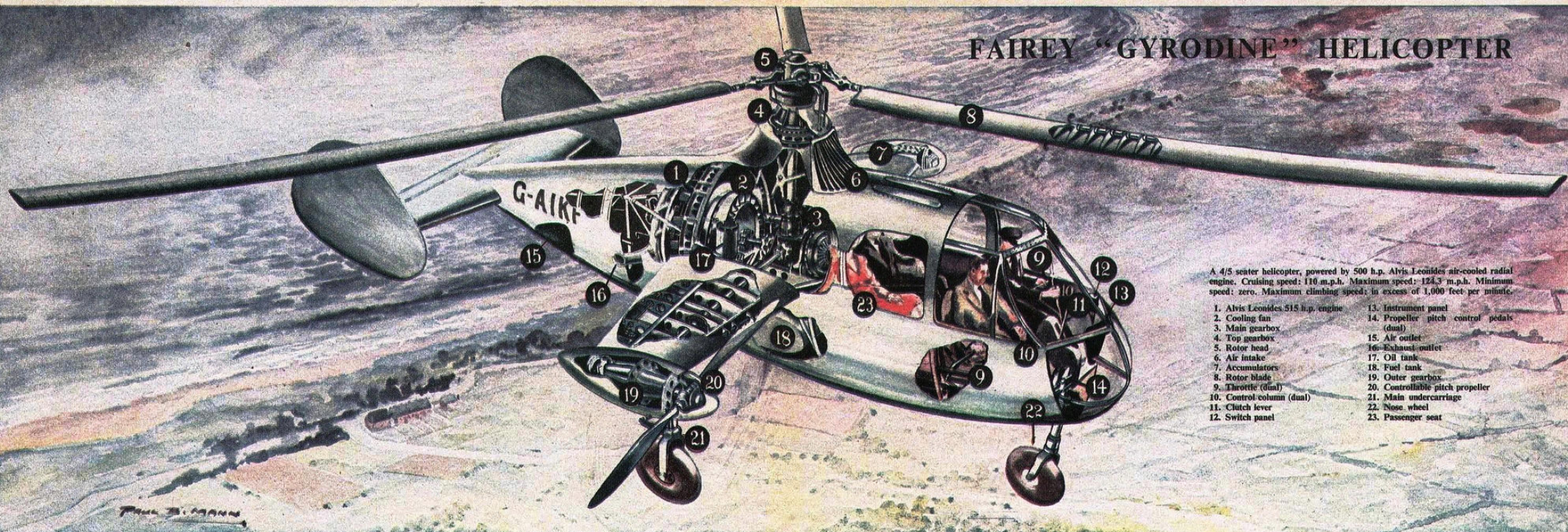
WOULD YOU LIKE A FLIGHT IN A HELICOPTER?
SEE OUR SPECIAL FORTNIGHTLY COMPETITION
ON THE EDITOR'S PAGE!

KEY TO HOW IT WORKS

- (1) Radial cylinders of forward Alvis Leonides engine. (2) Air cooling fan. (3) Clutch mechanism. (4) Reduction gearing for rotor. (5) Rotor blades, the pitch of these can be altered by the pilot for hovering or forward movement. (6) Individual pitch control. (7) Pitch control for both rotors together. (8) Pitch control lever. (9) Fore and aft trim control wheel. (10) Cooling air inlet. (11) Cooling air and engine exhaust outlet. (12) Petrol tank (75 gallons). (13) Oil tank. (14) Oil cooler. (15) Synchronising shaft between engines. (16) Pitch control rods to rear. (17) Intermediate gearbox. (18) Rear Alvis Leonides engine. (19) Rotor reduction gears. (20) Blades of rear rotor. (21) Pitch control rods. (22) Cooling air inlet. (23) Cooling air and engine exhaust outlet. (24) Butterfly tailplane with fore and aft trim. (25) Fireproof bulkhead. (26) Passengers entrance door. (27) Cabin seating 13 passengers. (28) Fireproof bulkhead. (29) Front wheels with castor steering action. (30) Pilot. (31) Co-pilot and radio operator.



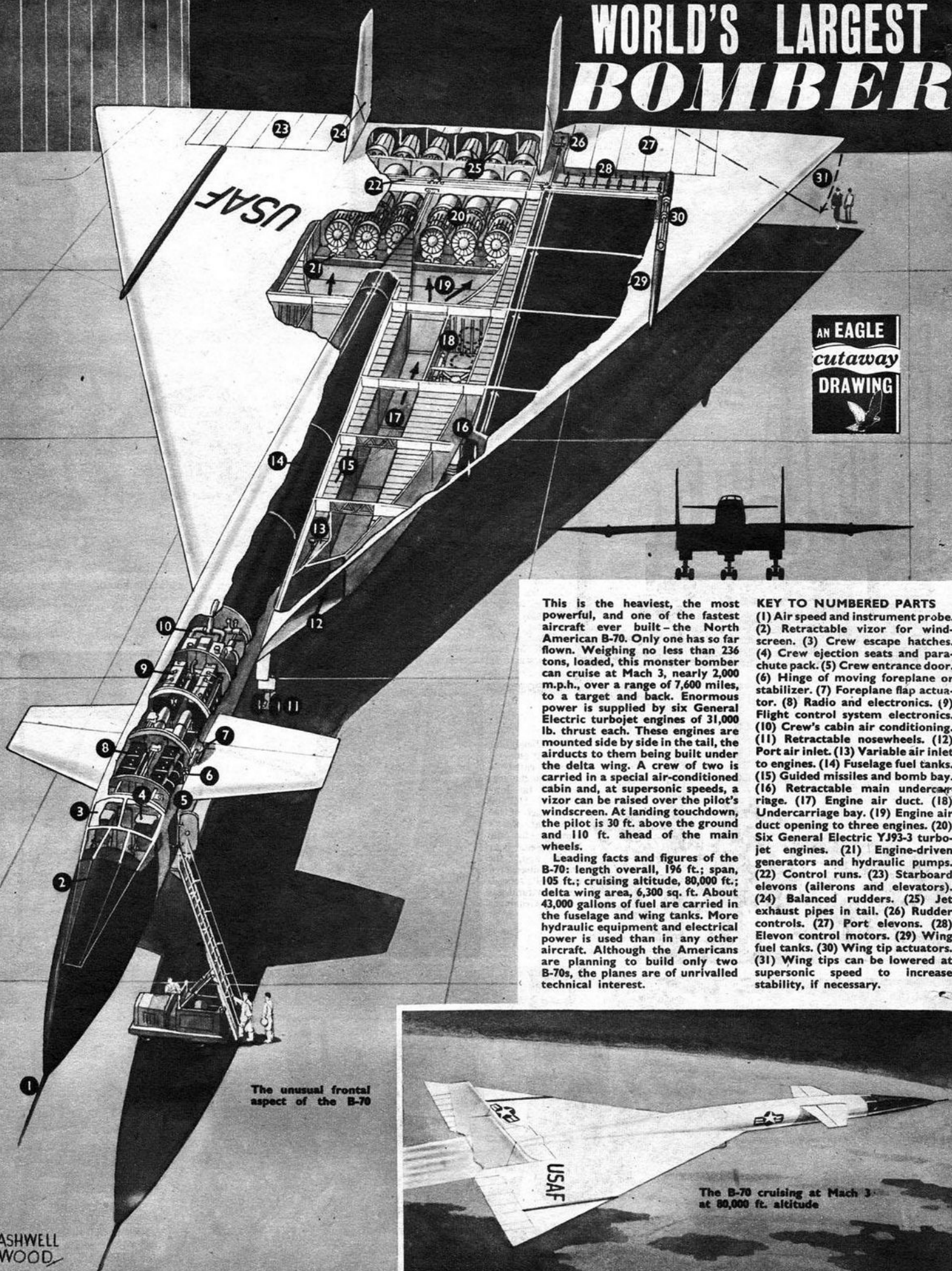
FAIREY "GYRODINE" HELICOPTER



A 4/5 seater helicopter, powered by 500 h.p. Alvis Leonides air-cooled radial engine. Cruising speed: 110 m.p.h. Maximum speed: 124.3 m.p.h. Minimum speed: zero. Maximum climbing speed: in excess of 1,000 feet per minute.

- | | |
|-----------------------------------|---|
| 1. Alvis Leonides 515 h.p. engine | 13. Instrument panel |
| 2. Cooling fan | 14. Propeller pitch control pedals (dual) |
| 3. Main gearbox | 15. Air outlet |
| 4. Top gearbox | 16. Exhaust outlet |
| 5. Rotor head | 17. Oil tank |
| 6. Air intake | 18. Fuel tank |
| 7. Accumulators | 19. Outer gearbox |
| 8. Rotor blade | 20. Controllable pitch propeller |
| 9. Throttle (dual) | 21. Main undercarriage |
| 10. Control column (dual) | 22. Nose wheel |
| 11. Clutch lever | 23. Passenger seat |
| 12. Switch panel | |

WORLD'S LARGEST BOMBER



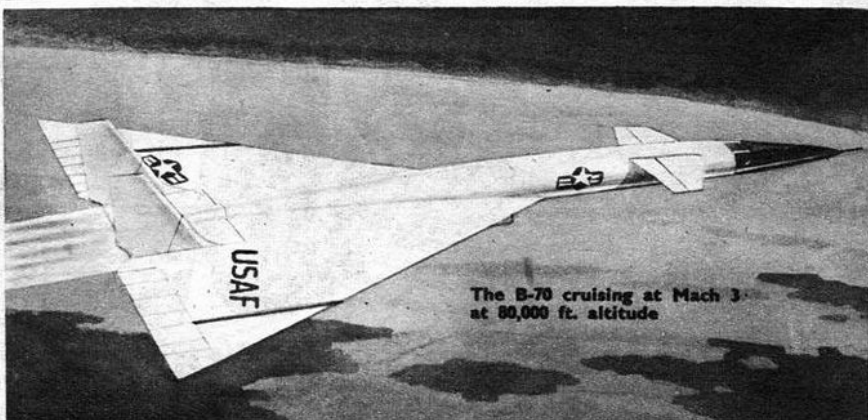
The unusual frontal aspect of the B-70

This is the heaviest, the most powerful, and one of the fastest aircraft ever built—the North American B-70. Only one has so far flown. Weighing no less than 236 tons, loaded, this monster bomber can cruise at Mach 3, nearly 2,000 m.p.h., over a range of 7,600 miles, to a target and back. Enormous power is supplied by six General Electric turbojet engines of 31,000 lb. thrust each. These engines are mounted side by side in the tail, the airducts to them being built under the delta wing. A crew of two is carried in a special air-conditioned cabin and, at supersonic speeds, a vizor can be raised over the pilot's windscreens. At landing touchdown, the pilot is 30 ft. above the ground and 110 ft. ahead of the main wheels.

Leading facts and figures of the B-70: length overall, 196 ft.; span, 105 ft.; cruising altitude, 80,000 ft.; delta wing area, 6,300 sq. ft. About 43,000 gallons of fuel are carried in the fuselage and wing tanks. More hydraulic equipment and electrical power is used than in any other aircraft. Although the Americans are planning to build only two B-70s, the planes are of unrivalled technical interest.

KEY TO NUMBERED PARTS

- (1) Air speed and instrument probe.
- (2) Retractable vizor for wind-screen.
- (3) Crew escape hatches.
- (4) Crew ejection seats and parachute pack.
- (5) Crew entrance door.
- (6) Hinge of moving foreplane or stabilizer.
- (7) Foreplane flap actuator.
- (8) Radio and electronics.
- (9) Flight control system electronics.
- (10) Crew's cabin air conditioning.
- (11) Retractable nosewheels.
- (12) Port air inlet.
- (13) Variable air inlet to engines.
- (14) Fuselage fuel tanks.
- (15) Guided missiles and bomb bay.
- (16) Retractable main undercarriage.
- (17) Engine air duct.
- (18) Undercarriage bay.
- (19) Engine air duct opening to three engines.
- (20) Six General Electric YJ93-3 turbojet engines.
- (21) Engine-driven generators and hydraulic pumps.
- (22) Control runs.
- (23) Starboard elevons (ailerons and elevators).
- (24) Balanced rudders.
- (25) Jet exhaust pipes in tail.
- (26) Rudder controls.
- (27) Port elevons.
- (28) Elevon control motors.
- (29) Wing fuel tanks.
- (30) Wing tip actuators.
- (31) Wing tips can be lowered at supersonic speed to increase stability, if necessary.



The B-70 cruising at Mach 3 at 80,000 ft. altitude

THE ANTARCTIC SHIP 'TOTTAN'



During the three years 1956-1958, the Royal Society Base, Halley Bay, on the south-eastern shores of the Weddell Sea, has been the scene of the main British contribution to the Antarctic International Geophysical Year programme. Twenty men have been at the base, working in the fields of meteorology, geomagnetism, aurora, radio studies, seismology and glaciology. The motor vessel *Tottan* has now made her fourth visit to Halley Bay, carrying provisions, fuel for base power-supply, scientific stores, etc. She will take off 19 of the men at base, of whom 16 have been there for two years. The 500-ton *Tottan*, under charter from her Norwegian owners, is specially strengthened for navigation in ice; she is 165 ft. long and has a speed of 11½ knots. We show her here unloading stores at Halley Bay – at present, the summer period – with an interested audience of penguins, who often came near to watch.

KEY TO NUMBERED PARTS: (1) Anchor winch. (2) Crew's quarters. (3) No. 1 hold. (4) Stores unloaded on the ice-shelf. (5) Fuel drums – aviation spirit for aircraft, petrol for tracked vehicles, Diesel oil for the electricity generators at the base, paraffin for heating and cooking, etc. (6) Section of the ice-shelf. (7)-(8) Two 3-ton derricks. (9) Derrick winches. (10) No. 2 hold. (11) Fuel bunker. (12) Stores in No. 2 hold. (13) 1,200 h.p. Diesel engine. (14) Diesel engine generator. (15) Fuel bunker; 150 tons of fuel in all. (16) Crew's quarters. (17) 5 ft. diameter propeller. (18) Rudder. (19) Steering machinery. (20) Fresh-water tanks. (21) Provisions and stores. (22) Cabins. (23) Hospital. (24) Shower-bath and washplace; crew's mess room and galley on the port side. (25) Engineer officers' quarters; officers' mess room on port side. (26) Captain's saloon. (27) Mate's cabin. (28) 15 ft. motor lifeboat. (29) Raft floats. (30) Navigation bridge. (31) Searchlight and compass. (32) Directional radio loop. (33) Radar scanner. (34) Galley flue-pipe.

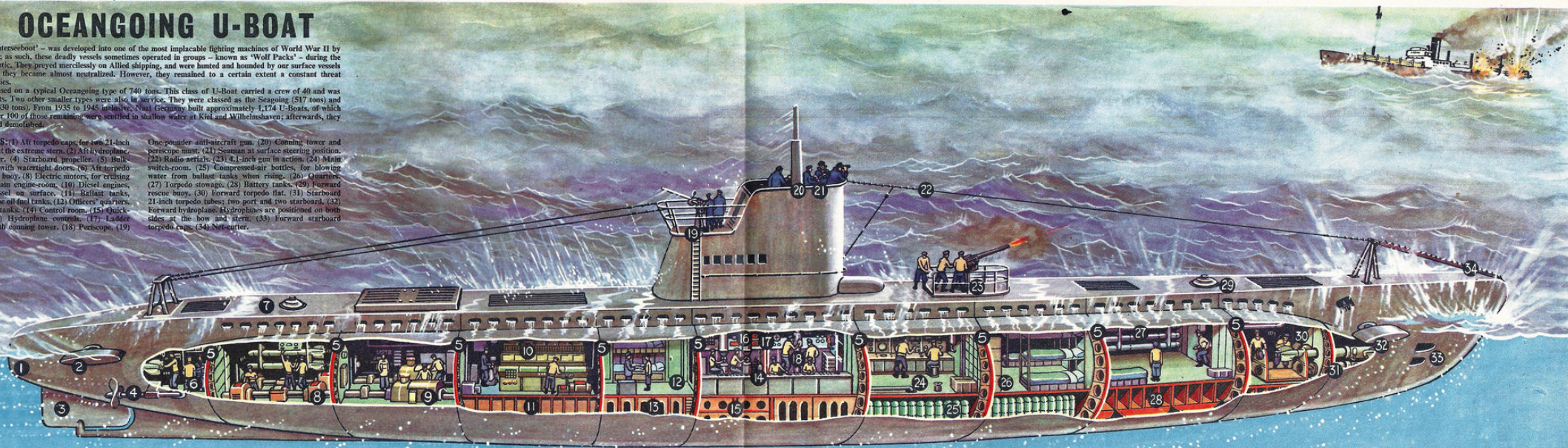
AN OCEANGOING U-BOAT

The U-Boat - 'Unterseeboot' - was developed into one of the most implacable fighting machines of World War II by the German Navy; as such, these deadly vessels sometimes operated in groups - known as 'Wolf Packs' - during the Battle of the Atlantic. They preyed mercilessly on Allied shipping, and were hunted and hounded by our surface vessels and aircraft until they became almost neutralized. However, they remained to a certain extent a constant threat throughout hostilities.

Our drawing is based on a typical Ocean-going type of 740 tons. This class of U-Boat carried a crew of 40 and was capable of 18 knots. Two other smaller types were also in service. They were classed as the Seagoing (517 tons) and the Coastal (250/330 tons). From 1935 to 1945 inclusive, Nazi Germany built approximately 1,174 U-Boats, of which 785 were lost. Over 100 of those remaining were scuttled in shallow water at Kiel and Wilhelmshaven; afterwards, they were re-floated and demolished.

KEY TO NUMBERS: (1) Air torpedo caps; for two 21-inch torpedoes located at the extreme stern. (2) Air hydroplane. (3) Vertical rudder. (4) Starboard propeller. (5) Bulkheads, each fitted with watertight doors. (6) Air torpedo flat. (7) Air rescue buoy. (8) Electric motor; for cruising submerged. (9) Main engine-room. (10) Diesel engines; for propelling vessel on surface. (11) Ballast tanks, behind which are the oil fuel tanks. (12) Officers' quarters. (13) Main ballast tanks. (14) Control room. (15) Quick-diving tanks. (16) Hydroplane controls. (17) Ladder communicating with conning tower. (18) Periscope. (19)

One-pounder anti-aircraft gun. (20) Conning tower and periscope mast. (21) Seaman at surface steering position. (22) Radio aerials. (23) 4.1-inch gun in action. (24) Main switch-room. (25) Compressed-air bottles, for blowing water from ballast tanks when rising. (26) Quarters. (27) Torpedo stowage. (28) Battery tanks. (29) Forward rescue buoy. (30) Forward torpedo flat. (31) Starboard 21-inch torpedo tubes; two port and two starboard. (32) Forward hydroplane. Hydroplanes are positioned on both sides at the bow and stern. (33) Forward starboard torpedo caps. (34) Net-cutter.

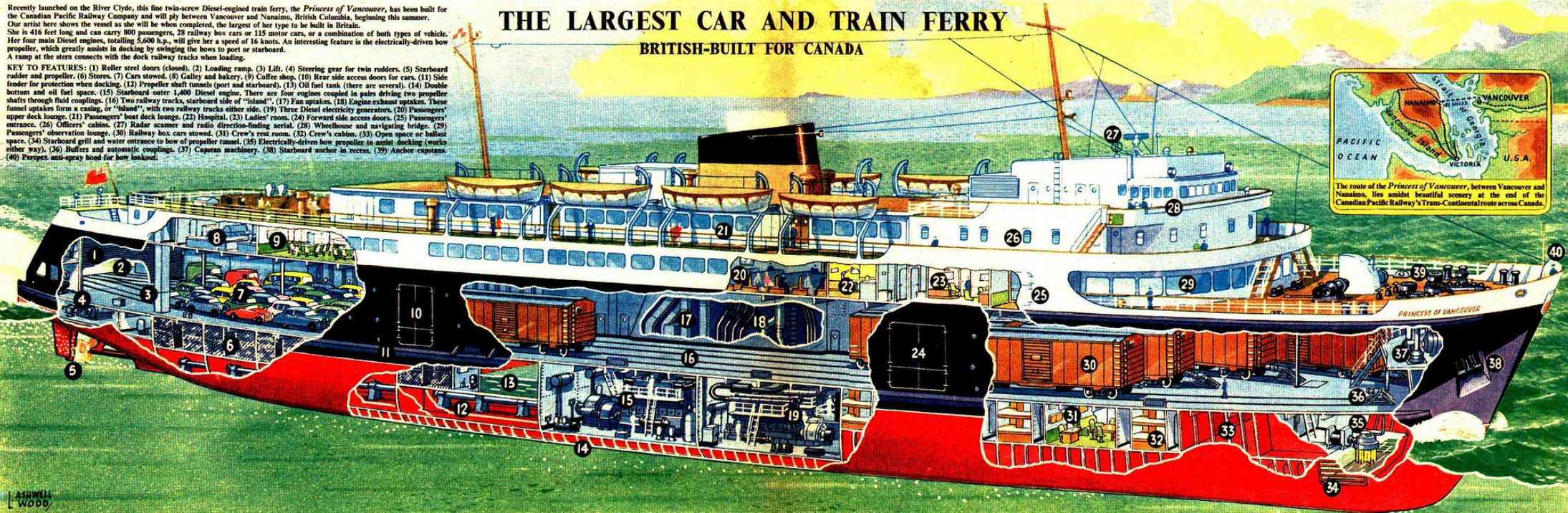
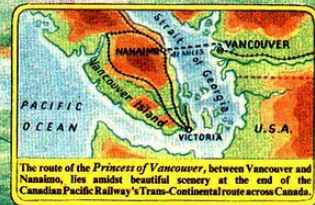


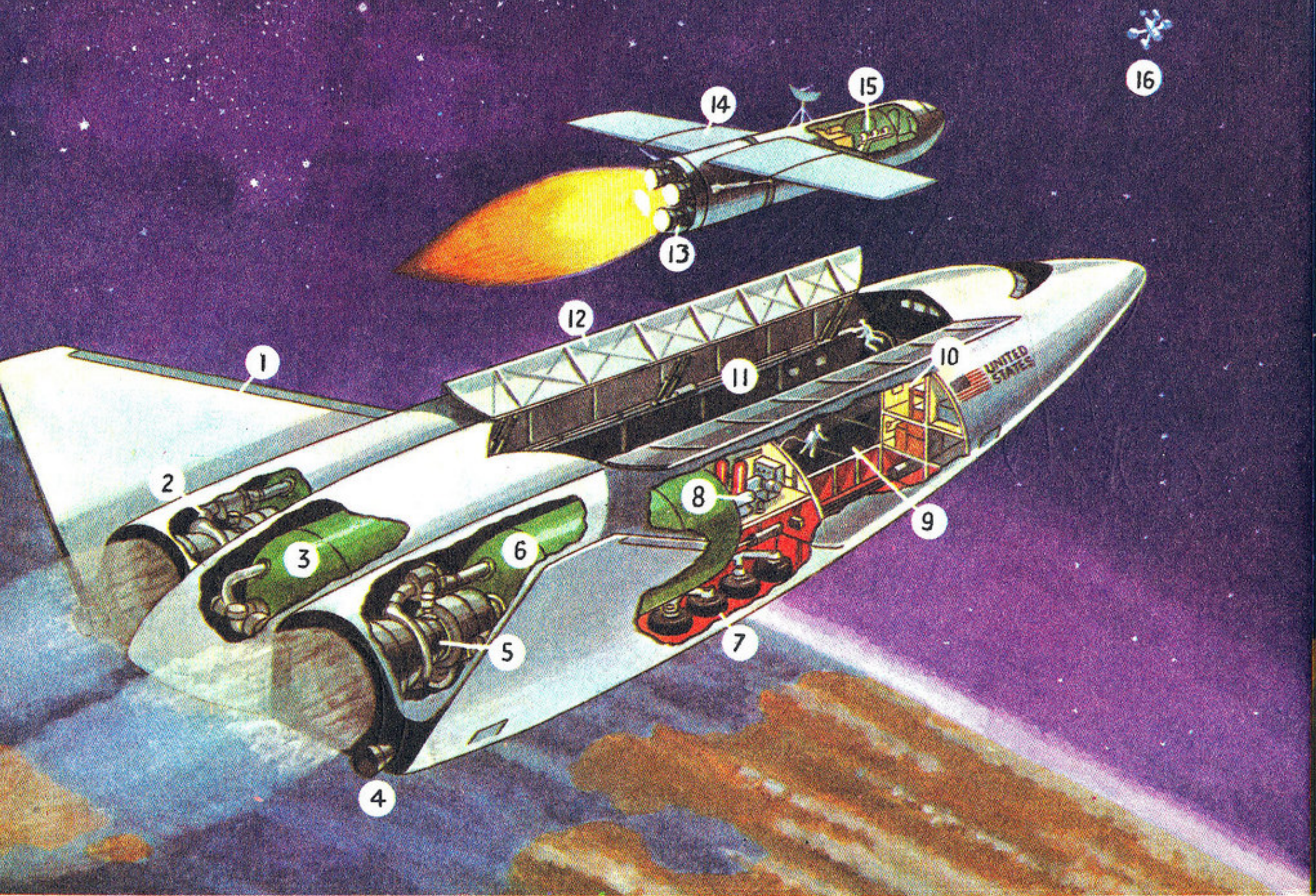
Recently launched on the River Clyde, this fine twin-screw Diesel-engined train ferry, the *Princess of Vancouver*, has been built for the Canadian Pacific Railway Company and will ply between Vancouver and Nanaimo, British Columbia, beginning this summer. Our artist here shows the vessel as she will be when completed, the largest of her type to be built in Britain. She is 416 feet long and can carry 800 passengers, 28 railway box cars or 115 motor cars, or a combination of both types of vehicle. Her four main Diesel engines, totalling 5,600 h.p., will give her a speed of 16 knots. An interesting feature is the electrically-driven bow propeller, which greatly assists in docking by swinging the bows to port or starboard. A ramp at the stern connects with the dock railway tracks when loading.

KEY TO FEATURES: (1) Roller steel doors (closed). (2) Loading ramp. (3) Lift. (4) Steering gear for twin rudders. (5) Starboard rudder and propeller. (6) Stores. (7) Cars stowed. (8) Galley and bakery. (9) Coffee shop. (10) Rear side access doors for cars. (11) Side fender for protection when docking. (12) Propeller shaft tunnels (port and starboard). (13) Oil fuel tank (there are several). (14) Double bottom and oil fuel space. (15) Starboard outer 1,400 Diesel engine. There are four engines coupled in pairs driving two propeller shafts through fluid couplings. (16) Two railway tracks, starboard side of "island". (17) Fan uptakes. (18) Engine exhaust uptakes. These funnel uptakes form a casing, or "island", with two railway tracks either side. (19) Three Diesel electricity generators. (20) Passengers' upper deck lounge. (21) Passengers' boat deck lounge. (22) Hospital. (23) Ladies' room. (24) Forward side access doors. (25) Passengers' entrance. (26) Officers' cabins. (27) Radar scanner and radio direction-finding aerial. (28) Wheelhouse and navigating bridge. (29) Passengers' observation lounge. (30) Railway box cars stowed. (31) Crew's rest room. (32) Crew's cabins. (33) Open space or ballast space. (34) Starboard grill and water entrance to bow of propeller tunnel. (35) Electrically-driven bow propeller to assist docking (works either way). (36) Buffers and automatic couplings. (37) Captain's machinery. (38) Starboard anchor in recess. (39) Anchor capstans. (40) Perspex anti-spray hood for bow lookout.

THE LARGEST CAR AND TRAIN FERRY

BRITISH-BUILT FOR CANADA





TO SPACE STATIONS AND BACK



These 4-8-4 Locomotives of the "6400" class weigh 296 tons and work the "International Limited" between Montreal, Toronto, and Sarnia, on the U.S.A. frontier

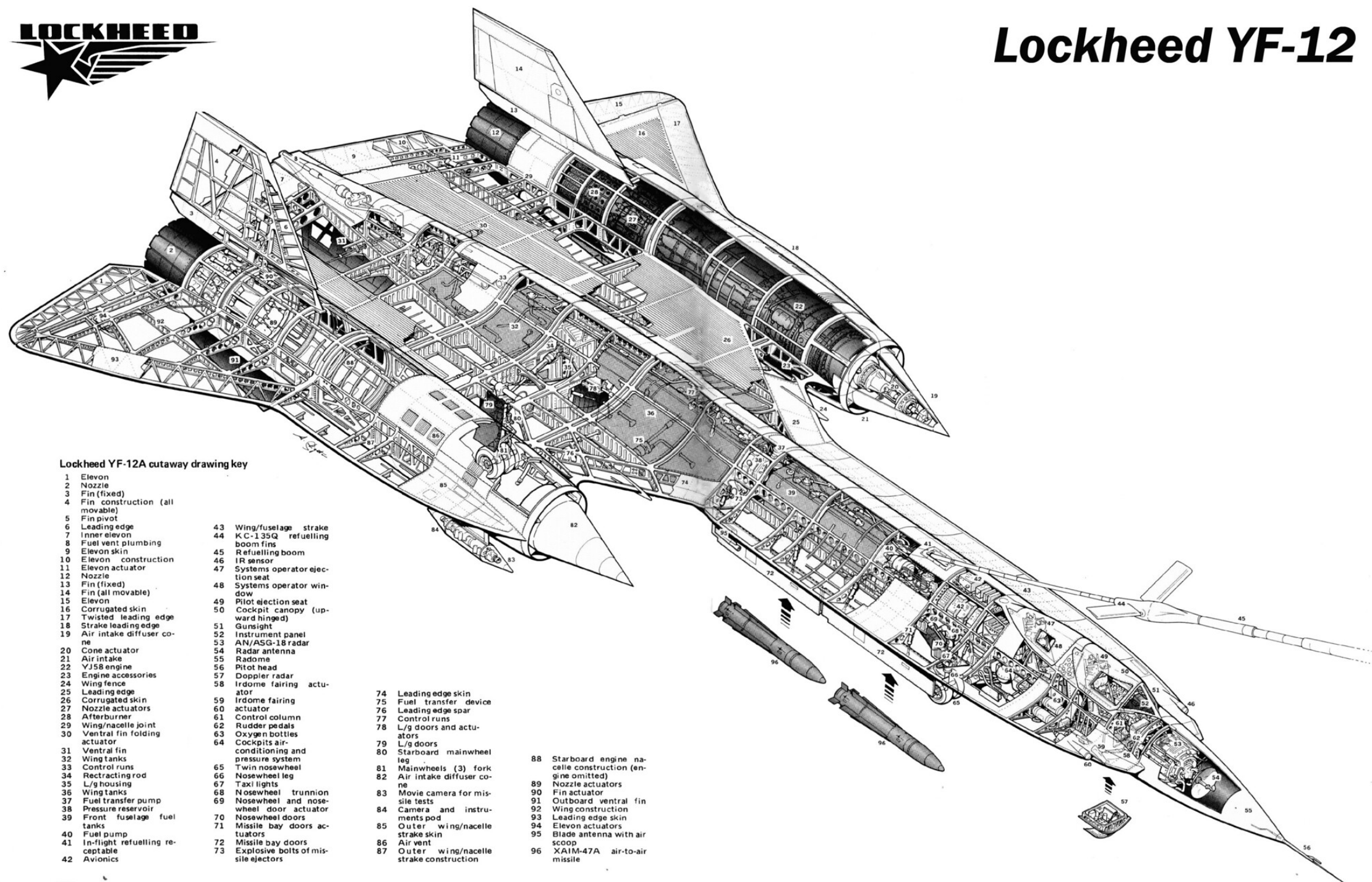
KEY TO HOW IT WORKS

- | | |
|--|--|
| 1. Water supply from tender to boiler by special
clack valves | 13. Baker-Pilliod piston valve control mechanism |
| 2. Steam rises to this dome and enters steam
pipe | 14. Connecting rod from piston to driving wheel and
coupling rods to coupled wheels |
| 3. Steam pipe to superheater | 15. Water level above firebox |
| 4. Superheater | 16. Firebox supported by stays above |
| 5. Outside regulator from driver's cab which con-
trols steam to superheater (This regulator and
driver are actually on the other side of the loco-
motive) | 17. Mechanical stoker |
| 6. Steam passes back into the boiler via these pipes
inside a flue and returns superheated | 18. Coal hopper carrying 20 tons |
| 7. Superheater flue pipes | 19. Coal feed screw |
| 8. Fire-tubes which heat the water | 20. Tender water capacity 11,700 gallons |
| 9. Superheated steam pipes to cylinders | 21. Safety valves |
| 10. Piston valves which control steam alternately
either side of piston | 22. Compressed air cylinders for brakes |
| 11. Piston (on the forward stroke) | 23. Sand supply dome for wheels (to prevent
skidding when starting) |
| 12. Exhaust blast pipe from cylinders | 24. Air-flow forces exhaust steam upwards |
| | 25. Warning bell |
| | 26. Streamlined outer casing |
| | 27. Electric headlamp |
| | 28. Side lamps |
| | 29. Automatic coupling door |

CANADIAN NATIONAL GIANT SEMI-STREAMLINED LOCOMOTIVE



Lockheed YF-12



Lockheed YF-12A cutaway drawing key

- | | |
|------------------------------------|--|
| 1 Elevon | 43 Wing/fuselage strake |
| 2 Nozzle | 44 KC-135Q refuelling boom fins |
| 3 Fin (fixed) | 45 Refuelling boom |
| 4 Fin construction (all movable) | 46 IR sensor |
| 5 Fin pivot | 47 Systems operator ejection seat |
| 6 Leading edge | 48 Systems operator window |
| 7 Inner elevon | 49 Pilot ejection seat |
| 8 Fuel vent plumbing | 50 Cockpit canopy (upward hinged) |
| 9 Elevon skin | 51 Gunsight |
| 10 Elevon construction | 52 Instrument panel |
| 11 Elevon actuator | 53 AN/ASG-18 radar |
| 12 Nozzle | 54 Radar antenna |
| 13 Fin (fixed) | 55 Radome |
| 14 Fin (all movable) | 56 Pitot head |
| 15 Elevon | 57 Doppler radar |
| 16 Corrugated skin | 58 Irdome fairing actuator |
| 17 Twisted leading edge | 59 Irdome fairing actuator |
| 18 Strake leading edge | 60 actuator |
| 19 Air intake diffuser cone | 61 Control column |
| 20 Cone actuator | 62 Rudder pedals |
| 21 Air intake | 63 Oxygen bottles |
| 22 YJ58 engine | 64 Cockpits air-conditioning and pressure system |
| 23 Engine accessories | 65 Twin nosewheel |
| 24 Wing fence | 66 Nosewheel leg |
| 25 Leading edge | 67 Taxi lights |
| 26 Corrugated skin | 68 Nosewheel trunnion |
| 27 Nozzle actuators | 69 Nosewheel and nosewheel door actuator |
| 28 Afterburner | 70 Nosewheel doors |
| 29 Wing/nacelle joint | 71 Missile bay doors actuators |
| 30 Ventral fin folding actuator | 72 Missile bay doors |
| 31 Ventral fin | 73 Explosive bolts of missile ejectors |
| 32 Wing tanks | |
| 33 Control runs | |
| 34 Retracting rod | |
| 35 L/g housing | |
| 36 Wing tanks | |
| 37 Fuel transfer pump | |
| 38 Pressure reservoir | |
| 39 Front fuselage fuel tanks | |
| 40 Fuel pump | |
| 41 In-flight refuelling receptacle | |
| 42 Avionics | |

- | | |
|---|---|
| 74 Leading edge skin | 88 Starboard engine nacelle construction (engine omitted) |
| 75 Fuel transfer device | 89 Nozzle actuators |
| 76 Leading edge spar | 90 Fin actuator |
| 77 Control runs | 91 Outboard ventral fin |
| 78 L/g doors and actuators | 92 Wing construction |
| 79 L/g doors | 93 Leading edge skin |
| 80 Starboard mainwheel leg | 94 Elevon actuators |
| 81 Mainwheels (3) fork | 95 Blade antenna with air scoop |
| 82 Air intake diffuser cone | 96 XAIM-47A air-to-air missile |
| 83 Movie camera for missile tests | |
| 84 Camera and instrument pod | |
| 85 Outer wing/nacelle strake skin | |
| 86 Air vent | |
| 87 Outer wing/nacelle strake construction | |

BRITAIN'S LATEST GAS-TURBINE LOCOMOTIVE

The first British built gas-turbine-electric locomotive No. 18100, has been built for British Railways by Messrs Metropolitan Vickers Electrical Co. Ltd. It will work on the Western Region, and is shown here crossing Brunel's engineering masterpiece, the Royal Albert Bridge, Saltash, over the River Tamar, which divides Devon and Cornwall. The new locomotive is 66 ft. 9 ins. long, weighs 129½ tons and is capable of a speed of 90 m.p.h. The gas turbine develops 3,000 h.p. for driving the three main generators, which produce current for the driving motors at 825 volts.

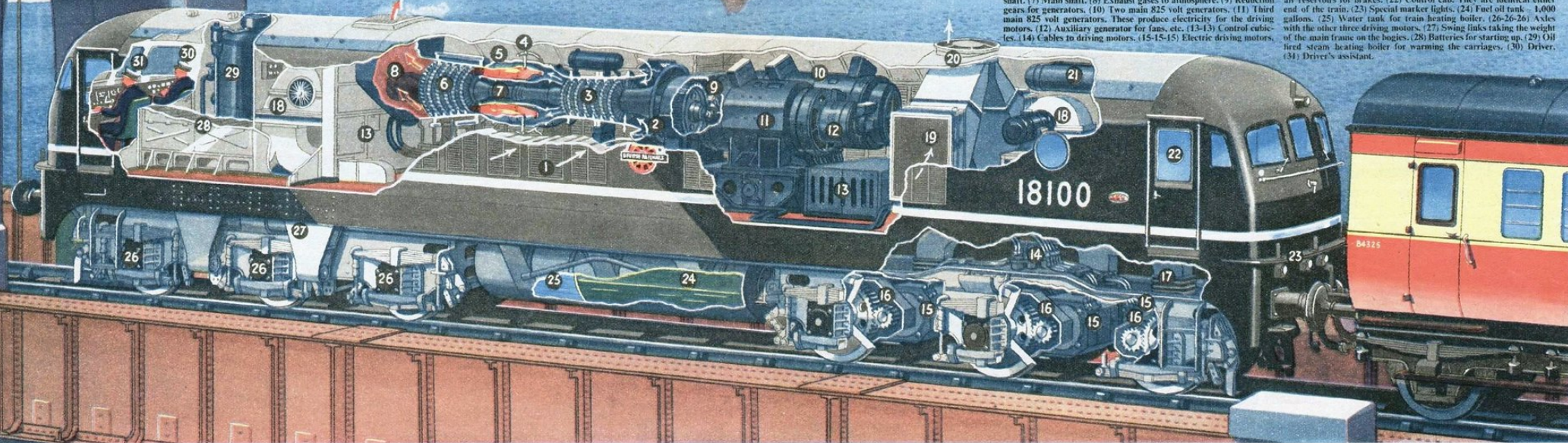
KEY TO CYCLE OF OPERATIONS

(1) Air entry through grill and filters. (2) Air intake to gas-turbine. (3) Axial flow air compressor. (4) Fuel oil supply. (5) Combustion chambers (six in all), where air and fuel are mixed and fired. (6) Gas turbine which drives the compressor and generators through main shaft. (7) Main shaft. (8) Exhaust gases to atmosphere. (9) Reduction gears for generators. (10) Two main 825 volt generators. (11) Third main 825 volt generator. These produce electricity for the driving motors. (12) Auxiliary generator for fans, etc. (13-13) Control cubicles. (14) Cables to driving motors. (15-15) Electric driving motors.

one on each axle (six in all). (16-16) Reduction driving gears. (17) Motor-cooling air ducts. (18-18) Blower fans supply air to motors.

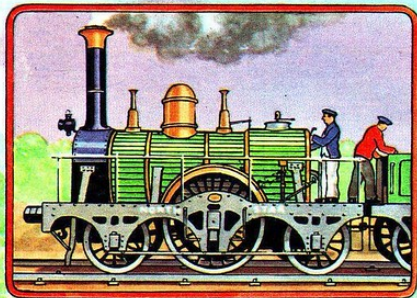
KEY TO OTHER PARTS

(19) Lubricating oil cooler. (20) Oil cooler air fan. (21) Compressed air reservoirs for brakes. (22) Control cab. They are identical either end of the train. (23) Special marker lights. (24) Fuel oil tank - 1,000 gallons. (25) Water tank for train heating boiler. (26-26) Axles with the other three driving motors. (27) Swing links taking the weight of the main frame on the bogies. (28) Batteries for starting up. (29) Oil fired steam heating boiler for warming the carriages. (30) Driver. (31) Driver's assistant.



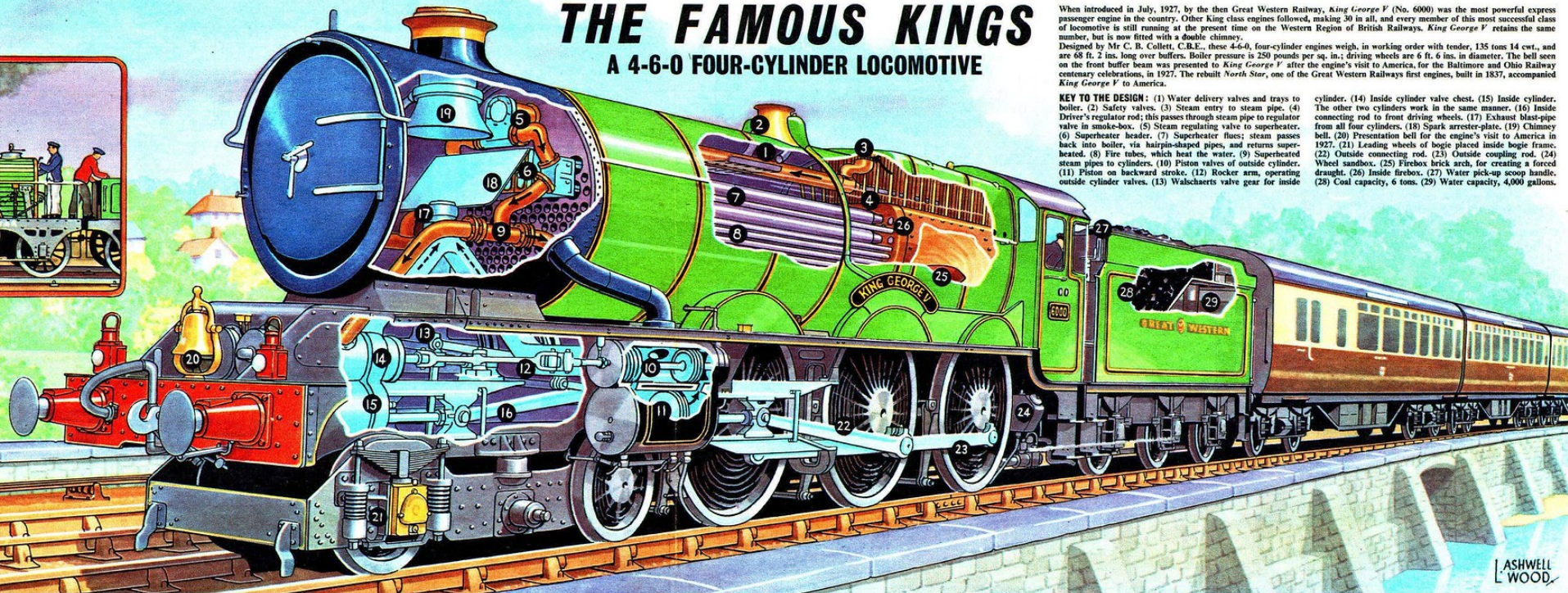
THE FAMOUS KINGS

A 4-6-0 FOUR-CYLINDER LOCOMOTIVE



THE LOCOMOTIVE'S ANCESTOR

The evolution of the Kings may be traced back to the famous *North Star*, built in 1837 for the Great Western Railway, and one of the best engines of its day. Steam pressure was only 50 pounds per sq. in., and the driving wheels 7 ft. in diameter. Many of the old-time engine's characteristics will be found in locomotives of today.



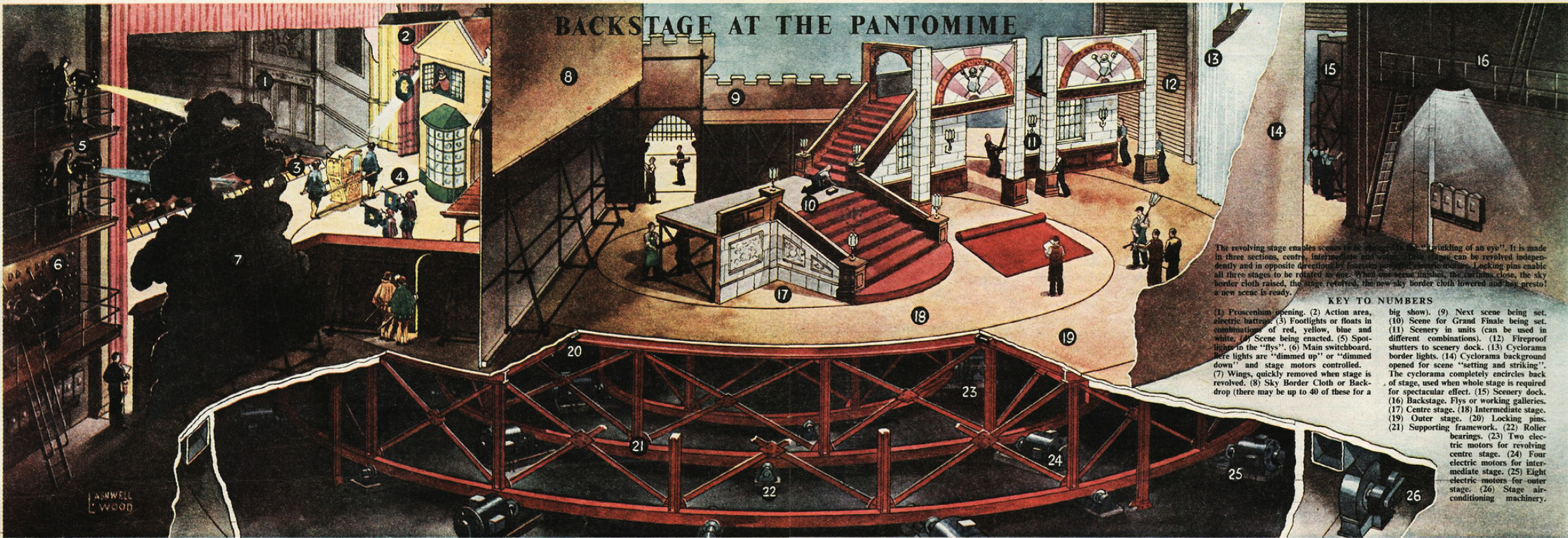
When introduced in July, 1927, by the then Great Western Railway, *King George V* (No. 6000) was the most powerful express passenger engine in the country. Other King class engines followed, making 30 in all, and every member of this most successful class of locomotive is still running at the present time on the Western Region of British Railways. *King George V* retains the same number, but is now fitted with a double chimney.

Designed by Mr C. B. Collett, C.B.E., these 4-6-0, four-cylinder engines weigh, in working order with tender, 135 tons 14 cwt., and are 68 ft. 2 ins. long over buffers. Boiler pressure is 250 pounds per sq. in.; driving wheels are 6 ft. 6 ins. in diameter. The bell seen on the front buffer beam was presented to *King George V* after the engine's visit to America, for the Baltimore and Ohio Railway centenary celebrations, in 1927. The rebuilt *North Star*, one of the Great Western Railway's first engines, built in 1837, accompanied *King George V* to America.

KEY TO THE DESIGN: (1) Water delivery valves and trays to boiler. (2) Safety valves. (3) Steam entry to steam pipe. (4) Driver's regulator rod; this passes through steam pipe to regulator valve in smoke-box. (5) Steam regulating valve to superheater. (6) Superheater header. (7) Superheater flues; steam passes back into boiler, via hairpin-shaped pipes, and returns superheated. (8) Fire tubes, which heat the water. (9) Superheated steam pipes to cylinders. (10) Piston valves of outside cylinder. (11) Piston on backward stroke. (12) Rocker arm, operating outside cylinder valves. (13) Walschaerts valve gear for inside

cylinder. (14) Inside cylinder valve chest. (15) Inside cylinder. The other two cylinders work in the same manner. (16) Inside connecting rod to front driving wheels. (17) Exhaust blast-pipe from all four cylinders. (18) Spark arrester-plate. (19) Chimney bell. (20) Presentation bell for the engine's visit to America in 1927. (21) Leading wheels of bogie placed inside bogie frame. (22) Outside connecting rod. (23) Outside coupling rod. (24) Wheel sandbox. (25) Firebox brick arch, for creating a forced draught. (26) Inside firebox. (27) Water pick-up scoop handle. (28) Coal capacity, 6 tons. (29) Water capacity, 4,000 gallons.

BACKSTAGE AT THE PANTOMIME



The revolving stage enables scenes to be changed in the "winking of an eye". It is made in three sections, centre, intermediate and outer. These stages can be revolved independently and in opposite directions by fourteen powerful electric motors. Locking pins enable all three stages to be rotated as one. When one scene finishes, the curtains close, the sky border cloth raised, the stage rotated, the new sky border cloth lowered and hey presto! a new scene is ready.

KEY TO NUMBERS

- (1) Proscenium opening. (2) Action area, electric battens. (3) Footlights or floats in combinations of red, yellow, blue and white. (4) Scene being enacted. (5) Spotlights in the "flies". (6) Main switchboard. Here lights are "dimmed up" or "dimmed down" and stage motors controlled. (7) Wings, quickly removed when stage is revolved. (8) Sky Border Cloth or Backdrop (there may be up to 40 of these for a big show). (9) Next scene being set. (10) Scene for Grand Finale being set. (11) Scenery in units (can be used in different combinations). (12) Fireproof shutters to scenery dock. (13) Cyclorama border lights. (14) Cyclorama background opened for scene "setting and striking". The cyclorama completely encircles back of stage, used when whole stage is required for spectacular effect. (15) Scenery dock. (16) Backstage. Flies or working galleries. (17) Centre stage. (18) Intermediate stage. (19) Outer stage. (20) Locking pins. (21) Supporting framework. (22) Roller bearings. (23) Two electric motors for revolving centre stage. (24) Four electric motors for intermediate stage. (25) Eight electric motors for outer stage. (26) Stage air-conditioning machinery.

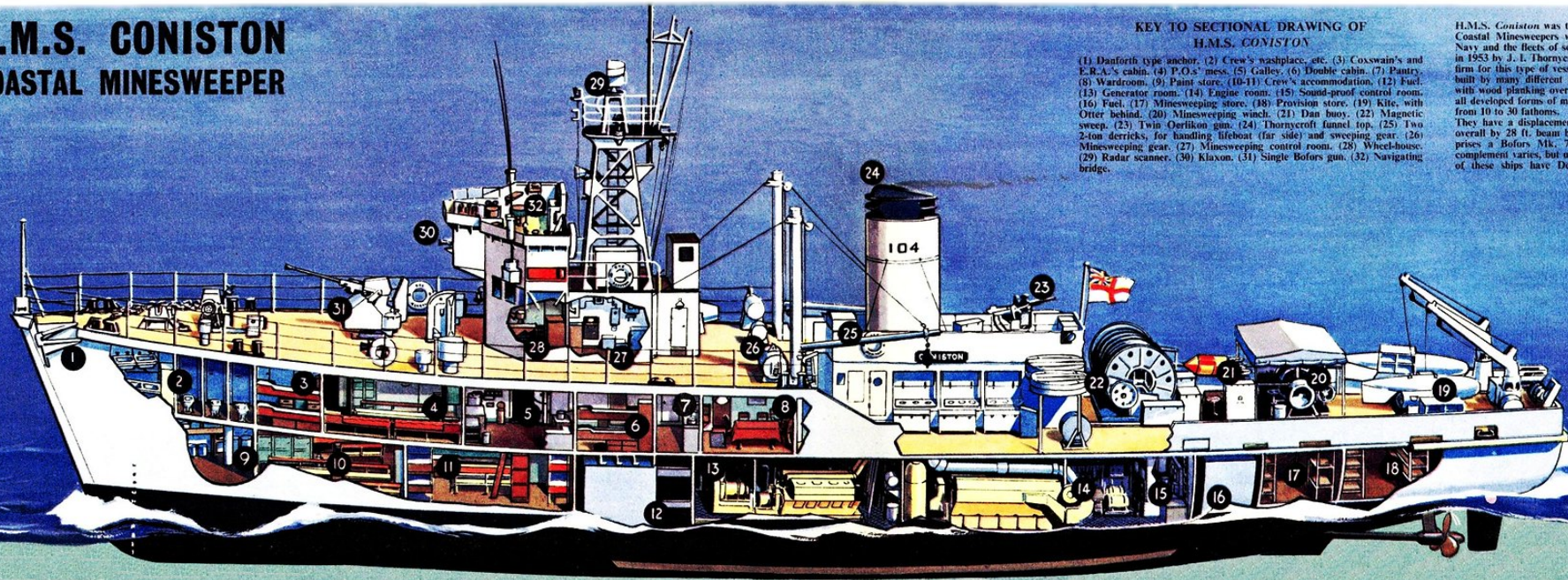
H.M.S. CONISTON

COASTAL MINESWEEPER

KEY TO SECTIONAL DRAWING OF H.M.S. CONISTON

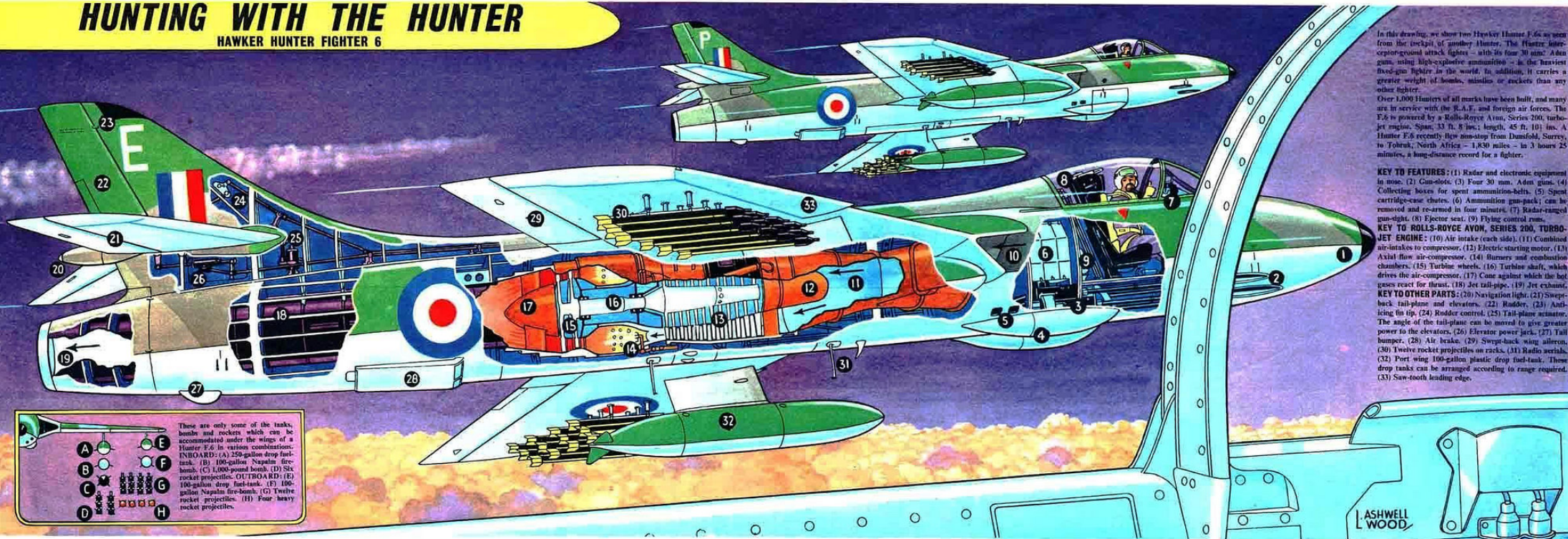
- (1) Danforth type anchor. (2) Crew's washplace, etc. (3) Coxswain's and E.R.A.'s cabin. (4) P.O.s' mess. (5) Galley. (6) Double cabin. (7) Pantry. (8) Wardroom. (9) Paint store. (10-11) Crew's accommodation. (12) Fuel. (13) Generator room. (14) Engine room. (15) Sound-proof control room. (16) Fuel. (17) Minesweeping store. (18) Provision store. (19) Kite, with Otter behind. (20) Minesweeping winch. (21) Dan buoy. (22) Magnetic sweep. (23) Twin Oerlikon gun. (24) Thornycroft funnel top. (25) Two 2-ton derricks, for handling lifeboat (far side) and sweeping gear. (26) Minesweeping gear. (27) Minesweeping control room. (28) Wheel-house. (29) Radar scanner. (30) Klaxon. (31) Single Bofors gun. (32) Navigating bridge.

H.M.S. *Coniston* was the first of the now very numerous fleet of Motor Coastal Minesweepers which has been built for service with the Royal Navy and the fleets of several other N.A.T.O. powers. She was completed in 1953 by J. I. Thornycroft & Co. Ltd., Southampton, which is the parent firm for this type of vessel. These Coastal Minesweepers, which are being built by many different firms, are constructed of non-magnetic materials, with wood planking over light alloy frames. They are designed to operate all developed forms of magnetic minesweeping equipment in depths ranging from 10 to 30 fathoms. They have a displacement tonnage of 445, and measure 153 ft. in length overall by 28 ft. beam by 8 ft. maximum draught. Their armament comprises a Bofors Mk. 7 and twin power-operated Oerlikon guns. The complement varies, but usually totals about 3 officers and 30 ratings. Some of these ships have Deltic engines, but the *Coniston* is powered by Mirlees vee-type exhaust-gas turbo-charged engines, each with 12 cylinders and capable of developing 1,250 h.p. Forward of these, there is a 375-kW, 220-volt generator which provides power for the sweeping winch and the impulse current needed when magnetic loop sweeps are being carried out. Though small, these ships have very good accommodation, but their shallow draught makes them remarkably lively at sea.



HUNTING WITH THE HUNTER

HAWKER HUNTER FIGHTER 6



In this drawing, we show two Hawker Hunter F.6s as seen from the cockpit of another Hunter. The Hunter is an inter-ceptor-ground attack fighter - with its four 30 mm. Aden guns, using high-explosive ammunition - is the heaviest fixed-gun fighter in the world. In addition, it carries a greater weight of bombs, missiles or rockets than any other fighter.

Over 1,000 Hunters of all marks have been built, and many are in service with the R.A.F. and foreign air forces. The F.6 is powered by a Rolls-Royce Avon, Series 200, turbo-jet engine. Span, 33 ft. 8 ins.; length, 45 ft. 10 1/2 ins. A Hunter F.6 recently flew non-stop from Dunsfold, Surrey, to Tobruk, North Africa - 1,830 miles - in 3 hours 25 minutes, a long-distance record for a fighter.

KEY TO FEATURES: (1) Radar and electronic equipment in nose. (2) Gun-slots. (3) Four 30 mm. Aden guns. (4) Collecting boxes for spent ammunition-belts. (5) Spent cartridge-case chutes. (6) Ammunition gun-pack; can be removed and re-armed in four minutes. (7) Radar-ranged gun-sight. (8) Ejector seat. (9) Flying control runs.

KEY TO ROLLS-ROYCE AVON, SERIES 200, TURBO-JET ENGINE: (10) Air intake (each side). (11) Combined air-intakes to compressor. (12) Electric starting motor. (13) Axial flow air-compressor. (14) Burners and combustion chambers. (15) Turbine wheels. (16) Turbine shaft, which drives the air-compressor. (17) Cone against which the hot gases react for thrust. (18) Jet tail-pipe. (19) Jet exhaust.

KEY TO OTHER PARTS: (20) Navigation light. (21) Sweep-back tail-plane and elevators. (22) Rudder. (23) Anti-icing fin tip. (24) Rudder control. (25) Tail-plane actuator. The angle of the tail-plane can be moved to give greater power to the elevators. (26) Elevator power jack. (27) Tail bumper. (28) Air brake. (29) Sweep-back wing aileron. (30) Twelve rocket projectiles on racks. (31) Radio aerials. (32) Port wing 100-gallon plastic drop fuel-tank. These drop tanks can be arranged according to range required. (33) Saw-tooth leading edge.

These are only some of the tanks, bombs and rockets which can be accommodated under the wings of a Hunter F.6 in various combinations. **INBOARD:** (A) 250-gallon drop fuel-tank. (B) 100-gallon Napalm fire-bomb. (C) 1,000-pound bomb. (D) Six rocket projectiles. **OUTBOARD:** (E) 100-gallon drop fuel-tank. (F) 100-gallon Napalm fire-bomb. (G) Twelve rocket projectiles. (H) Four heavy rocket projectiles.



ASHWELL
WOOD

THE FIRST ATLANTIC FLIGHT

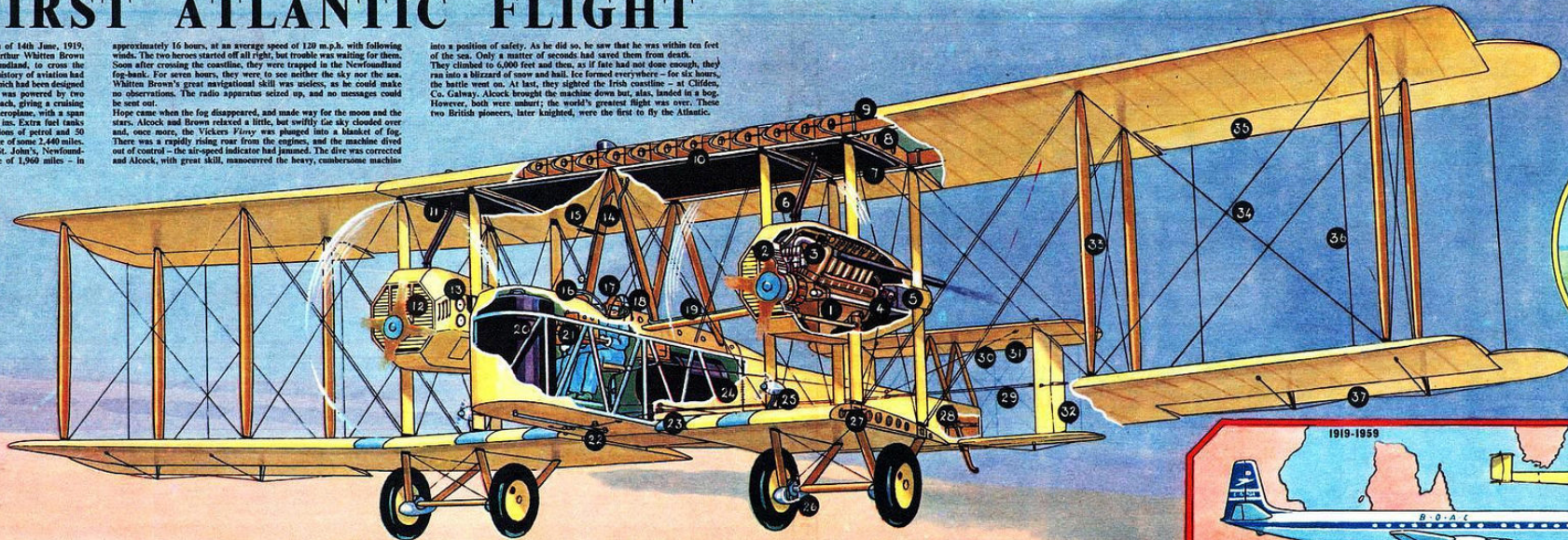
Soon after four o'clock on the Saturday afternoon of 14th June, 1919, Captain John Alcock (the pilot) and Lieutenant Arthur Whitten Brown (the navigator) took off from St. John's, Newfoundland, to cross the Atlantic. Forty years ago, the greatest flight in the history of aviation had begun. Their machine was a Vickers Vimy biplane, which had been designed during the war of 1914-18 as a heavy bomber. It was powered by two Rolls-Royce Eagle VIII petrol engines of 360 h.p. each, giving a cruising speed of 90 m.p.h. The Vickers Vimy was a large aeroplane, with a span of 68 ft., length of 42 ft. 8 ins. and height of 15 ft. 3 ins. Extra fuel tanks were added to enable the machine to take 865 gallons of petrol and 50 gallons of oil; loaded weight was 6 tons, with a range of some 2,440 miles. Alcock and Brown made their historic flight from St. John's, Newfoundland, to Clifden, Co. Galway, Ireland - a distance of 1,960 miles - in

approximately 16 hours, at an average speed of 120 m.p.h. with following winds. The two heroes started off all right, but trouble was waiting for them. Soon after crossing the coastline, they were trapped in the Newfoundland fog-bank. For seven hours, they were, to see neither the sky nor the sea. Whitten Brown's great navigational skill was useless, as he could make no observations. The radio apparatus seized up, and no messages could be sent out. Hope came when the fog disappeared, and made way for the moon and the stars. Alcock and Brown relaxed a little, but swiftly the sky clouded over and, once more, the Vickers Vimy was plunged into a blanket of fog. There was a rapidly rising roar from the engines, and the machine dove out of control - the air-speed indicator had jammed. The dive was corrected and Alcock, with great skill, manoeuvred the heavy, cumbersome machine

into a position of safety. As he did so, he saw that he was within ten feet of the sea. Only a matter of seconds had saved them from death. They climbed to 6,000 feet and then, as if fate had not done enough, they ran into a blizzard of snow and hail. Ice formed everywhere - for six hours, the battle went on. At last, they sighted the Irish coastline - at Clifden, Co. Galway. Alcock brought the machine down but, alas, landed in a bog. However, both were unhurt; the world's greatest flight was over. These two British pioneers, later knighted, were the first to fly the Atlantic.

KEY TO THE VICKERS VIMY BIPLANE

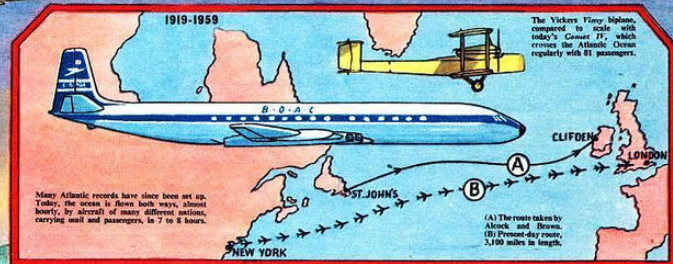
(1) 360 h.p. Rolls-Royce, V-12 cylinder Eagle VIII engine. (2) Radiator and shutters. (3) Twin carburettors. (4) Magnetos. (5) Oil tank. (6) Radiator water-pipes. (7) Radiator header-tank. (8) Wood box-spars and wing-ribs. The wings, tailplane and fuselage were covered with canvas. (9) Top aileron connecting-wire. (10) Main petrol tank. (11) Radiator header-tank. (12) Starboard engine nacelle. (13) Engine rev. and oil indicators. (14) Petrol pipes to and from main tank. (15) Air-speed indicator (this jammed). (16) Captain John Alcock, pilot. (17) Lieutenant Arthur Whitten Brown, navigator. (18) Propeller guard. (19) Petrol pipe and controls to port engine. (20) Nose petrol-tank. (21) Radio (this seized up). (22) Petrol pipe from nose tank. The main tank was refilled by use of a small hand-pump in the cockpit. (23) Elevator, rudder and aileron control wires. (24) Fuselage petrol-tank. (25) Wind-driven electricity generators. (26) Elastic shock-absorbers for landing wheels. (27) Lower aileron control wire. (28) Elastic-bound tail-bumper. (29) Port rudder control wires. (30) Elevator control wire. (31) Elevator. (32) Port rudder. (33) Solid spruce-wood struts. (34) Bracing wires. (35) Top port aileron. (36) Aileron connecting-wires. (37) Lower port aileron.



THE END OF THE JOURNEY



At 8.25 a.m. on 15th June, 1919, Alcock and Brown sighted Ireland, and circled over the radio station at Clifden. Alcock decided to land on what he thought was a 'nice meadow'. It turned out to be a bog. The wheels sank in and the lower plane was swished, but the flyers escaped unhurt.



H.M. AIRCRAFT CARRIER *ALBION*

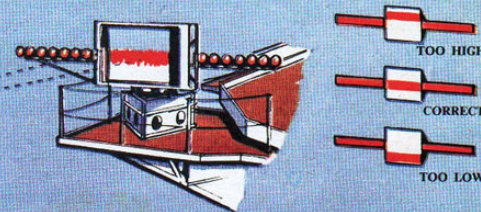
This new 18,000 ton Aircraft Carrier belongs to the *Hermes* class, of which three were completed in 1954, the others being named *BULWARK* and *CENTAUR*. The *ALBION* was built at Wallsend-on-Tyne by Swan Hunter & Wigham Richardson Ltd., and measures 737 ft. in overall length and 123 ft. in extreme breadth. She has a peacetime complement of approximately 1,300 officers and men. Two sets of geared turbines give a speed of some 30 knots.

These three ships are the first in the Royal Navy to be fitted with the new angled deck. If, while landing-on, an aircraft misses the arrestor wires, the pilot no longer faces running into the barrier, but merely opens his throttle and takes off to make another landing. As the diagrams show, the new arrangement also permits a much greater parking area for planes. In these ships the planes land at an angle of 5½ degrees to port, but in future carriers the flight deck will be made yet wider, so that this angle can be increased to one of about 10 degrees.

The *ALBION* is the first carrier to be fitted with the new Mirror Landing Sight. This device enables the pilot of an aircraft to come in and land on a predetermined flight path by keeping a reflected light in the centre of the mirror.

MIRROR LANDING SIGHT

AS SEEN FROM APPROACHING PLANE



BEAM OF LIGHT
REFLECTED
FROM AFT

PREVIOUS
FLIGHT DECK
LAYOUT



Arrow points to BARRIER

H.M.S. *ALBION*,
INTERIM STAGE -
5½ DEGREES



Arrow points to PARKING AREA

U.S.S. *FORRESTAL*,
NOW BUILDING -
10 DEGREE ANGLE



Arrow points to SIDE LIFTS

KEY TO DRAWING OF H.M.S. *ALBION*

(1) Aircraft catapults. (2) Mirror landing sight. (3) Lights reflecting into mirror. (4) Aircraft arrestor wires (six). (5) After aircraft lift. (6) Hangar space. (7) Radar gun control gear. (8) Navigating Bridge. (9) Ops Room. (10) Twin 40 mm. Bofors guns. (11) Hinged whip aerials. (12) Single Bofors guns. (13) Twin Bofors guns. (14) Single Bofors guns on after Gun Platform. (15) Six-barrelled Bofors guns. (16) Motor launch (left) and fast 35 ft. motorboat (right). (17) Boiler uptakes. (18) Forward boiler room. (19) Forward engine room. (20) After boiler room. (21) After engine room. (22) Engineers' workshop. (23) Diesel generator rooms. (24) Fuel tanks. (25) Fuel working space. (26) Tiller flat. (27) Starboard rudder. (28) Admiral's dining room. (29) Admiral's suite. (30) Officers' cabins. (31) Quarter deck. (32) Wardrooms. (33) W/T office. (34) Inflatable life-rafts. (35) Officers' cabins. (36) Air Department's mess. (37) Seamen's mess. (38) Officers' bathrooms. (39) Mess Rooms for Marines, Stokers, E.R.A.s, etc. (40) Crew's washplaces and bathrooms. (41) Stores. (42) Fan flat. (43) Stores, etc. (44) Hose stowage platform. (45) Captain's sea cabin. (46) Laundry.

THE LARGEST BRITISH-BUILT ELECTRIC LOCOMOTIVES FOR SPANISH NATIONAL RAILWAYS

Built by the Vulcan Foundry Ltd., and The English Electric Co. Ltd., these electric locomotives are among the most powerful in the world. Sixty of them have been ordered, and they are built to the Spanish gauge of 5 ft. 6 ins.

They are of 3,600 h.p. and operate on 3,000-volts direct current, supplying the six traction motors of 6,000 h.p. each, one motor to each axle. The current is collected by either one or both pantographs mounted on the roof. Control cabins are situated each end to save reversing.

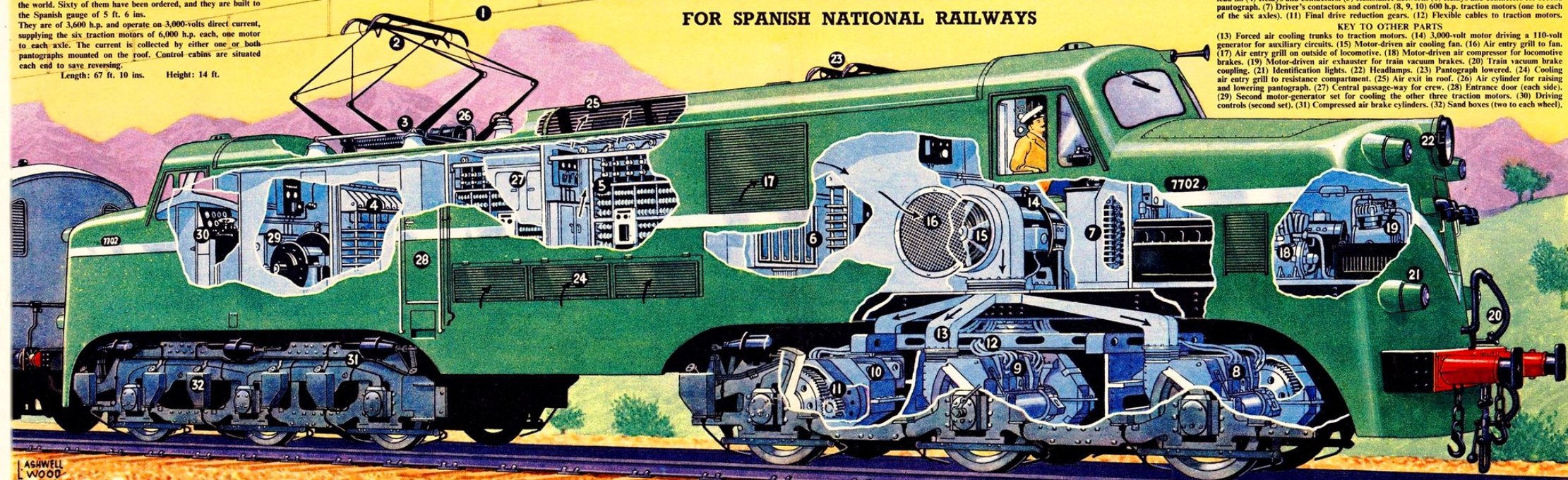
Length: 67 ft. 10 ins. Height: 14 ft.

KEY TO POWER CIRCUIT

(1) 3,000-volt direct current overhead power line. (2) Pantograph for collecting current. (3) Power lead in. (4) Relays and contactors. (5) Resistance network. (6) Relays and contactors for second pantograph. (7) Driver's contactors and control. (8, 9, 10) 600 h.p. traction motors (one to each of the six axles). (11) Final drive reduction gears. (12) Flexible cables to traction motors.

KEY TO OTHER PARTS

(13) Forced air cooling trunks to traction motors. (14) 3,000-volt motor driving a 110-volt generator for auxiliary circuits. (15) Motor-driven air cooling fan. (16) Air entry grill to fan. (17) Air entry grill on outside of locomotive. (18) Motor-driven air compressor for locomotive brakes. (19) Motor-driven air exhauster for train vacuum brakes. (20) Train vacuum brake coupling. (21) Identification lights. (22) Headlamps. (23) Pantograph lowered. (24) Cooling air entry grill to resistance compartment. (25) Air exit in roof. (26) Air cylinder for raising and lowering pantograph. (27) Central passage-way for crew. (28) Entrance door (each side). (29) Second motor-generator set for cooling the other three traction motors. (30) Driving controls (second set). (31) Compressed air brake cylinders. (32) Sand boxes (two to each wheel).



The Quebec Bridge, crossing the St. Lawrence river in Canada, is the longest cantilever span in the world. Its total span is 1,800 ft., and twice during construction it met with disaster. The whole structure suddenly collapsed and 75 men lost their lives. Work was re-started, and the centre span was nearing completion when one end broke away and the whole of the suspended span plunged into the river, killing 13 men.

A third attempt was made, which proved successful, and the bridge was finally completed in 1918. It cost about £3,000,000 to build and it shortens the route of the Canadian National Railway, between Halifax and Winnipeg, by 200 miles.

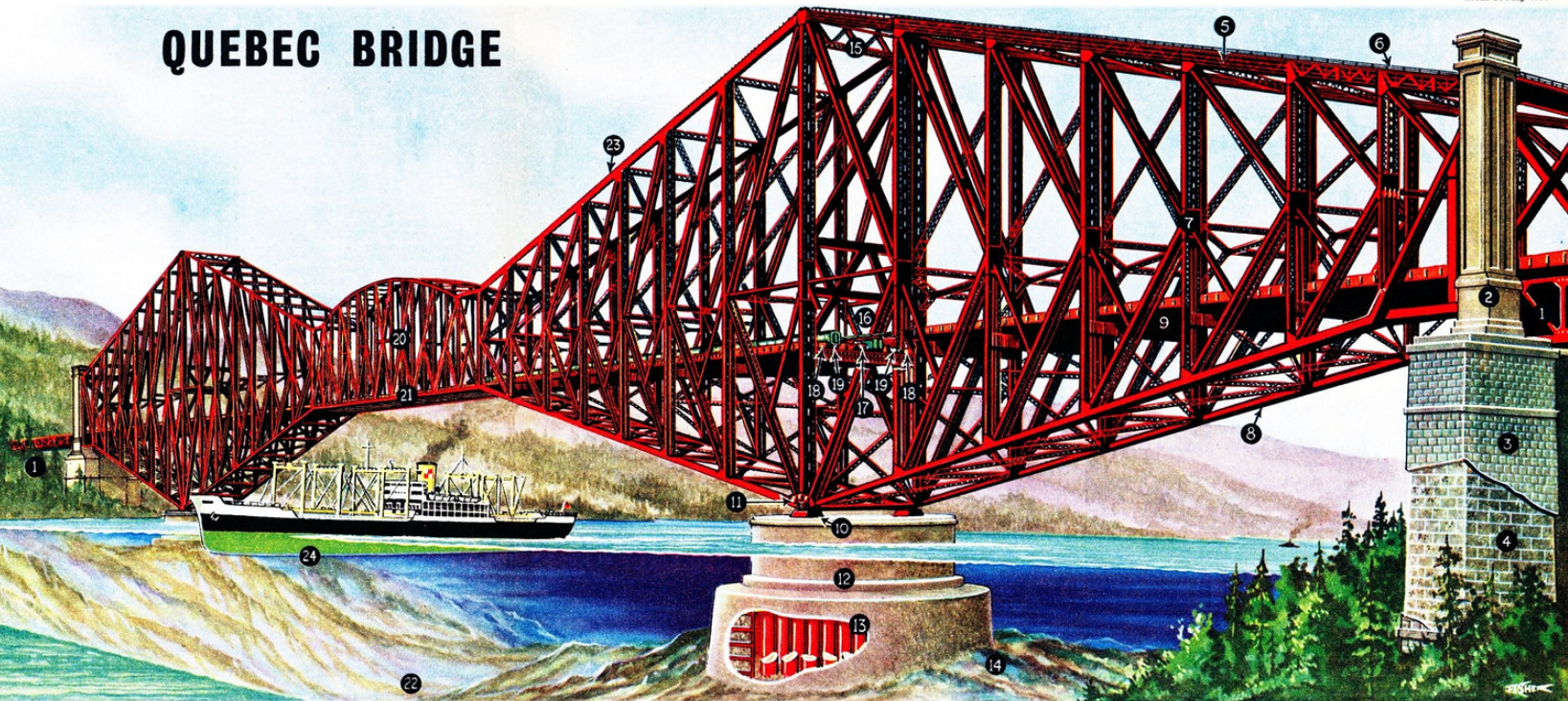
This wonderful bridge stands today – a proud monument to man's perseverance.

KEY TO NUMBERS

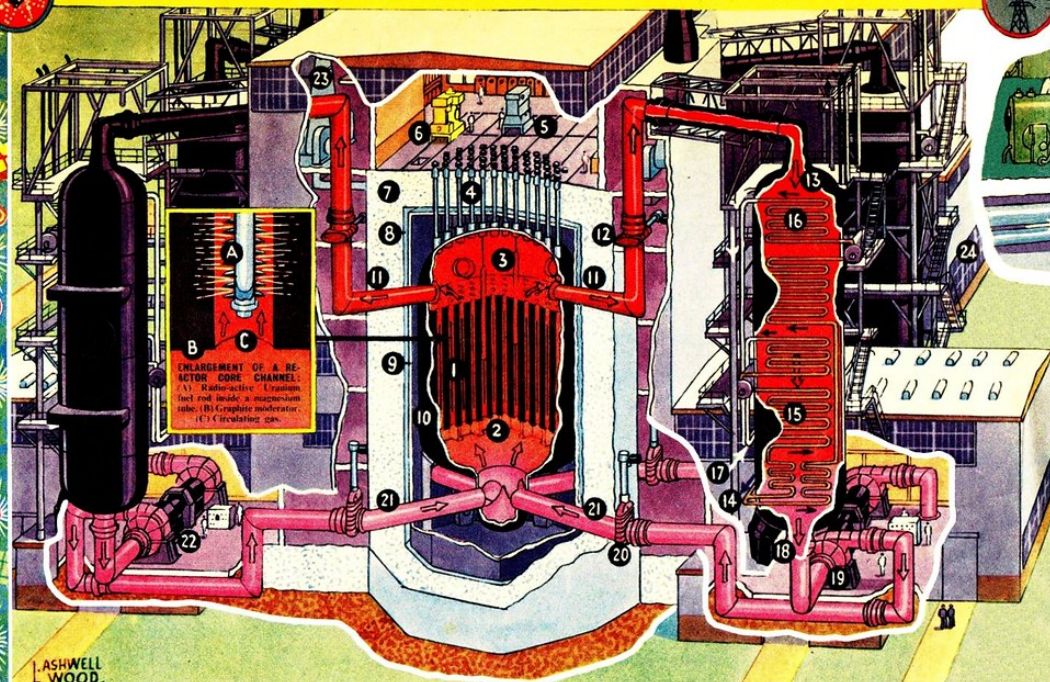
(1) Approach spans, (2) Anchor stanchions, (3) Granite facing, (4) Concrete pylon, (5) Anchor span, 500 ft. long, (6) Inspection footway, (7) 'K' trusses, (8) Compression chord. The collapse of these caused the first disaster. (9) Deck, (10) Bearing shoe, (11) Bearing pivot pins; unlike the cantilever towers of the Forth Bridge, which are entirely self-supporting, those of the Quebec Bridge are pivoted on cylindrical shoes. (12) Stone pier. The depth of the piers below high water is 101 ft. There is a difference of 14 ft. between high and low water. (13) Sunken caisson, filled with concrete based

on bedrock. (14) Mud. (15) Height of towers – 310 ft. (16) Section cut away showing – (17) 16 ft.-wide roadway; (18) Footways; (19) Railway tracks, (20) Centre span – 640 ft. long, weighing 5,000 tons. This is held by the cantilever spans, (21) Centre span – 150 ft. above water. It provides a thrill for liner passengers as, at first, they wonder if the masts of the ship will be able to pass under the bridge! (22) Depth of water under bridge – 200 ft. (23) Cantilever span – 580 ft. long. (24) Canadian Pacific 'Beaver' cargo-liner. (25) St. Lawrence river, with a 6-knot current.

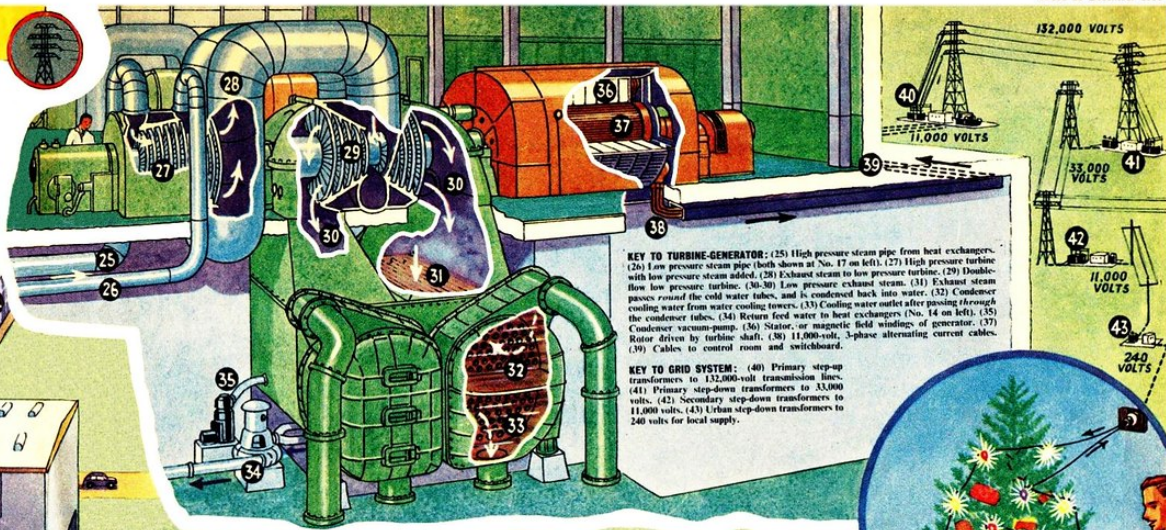
QUEBEC BRIDGE



ATOMIC - POWERED ELECTRICITY FOR CHRISTMAS



ASHWELL WOOD.



KEY TO TURBINE-GENERATOR: (25) High pressure steam pipe from heat exchangers. (26) Low pressure steam pipe (both shown at No. 17 on left). (27) High pressure turbine with low pressure steam added. (28) Exhaust steam to low pressure turbine. (29) Double-flow low pressure turbine. (30-30) Low pressure exhaust steam. (31) Exhaust steam passes round the cold water tubes, and is condensed back into water. (32) Condenser cooling water from water cooling towers. (33) Cooling water outlet after passing through the condenser tubes. (34) Return feed water to heat exchangers (No. 14 on left). (35) Condenser vacuum-pump. (36) Stator, or magnetic field windings of generator. (37) Rotor driven by turbine shaft. (38) 11,000-volt, 3-phase alternating current cables. (39) Cables to control room and switchboard.

KEY TO GRID SYSTEM: (40) Primary step-up transformers to 132,000-volt transmission lines. (41) Primary step-down transformers to 33,000 volts. (42) Secondary step-down transformers to 11,000 volts. (43) Urban step-down transformers to 240 volts for local supply.

Calder Hall, the world's first atomic power station, will be feeding electricity into the National Grid system this Christmas. Some 46,000 of our population will, unknown to themselves, be using this electricity for Christmas festivities and household services, but this is only half the eventual output of Calder Hall. In our last week's issue, we showed the whole layout of Calder Hall 'A' Station; in this special Christmas issue, we show in more detail how atomic power, or nuclear fission, is harnessed to the generation of electricity and how it reaches our homes. The nuclear power of one reactor is already saving Britain 2½ tons of coal every hour, with only two turbines running. Each of the four generators is capable of generating 23 megawatts of electricity. (1,000 watts is a kilowatt; 1,000 kilowatts, or 1,000,000 watts, is a megawatt.) Watts are a measure of power used, and a 100-watt electric lamp will use 100 watts in an hour. A one-kilowatt electric fire will use 1,000 watts in the same time, so one generator alone will produce 23,000,000 watts. Calder Hall is a British achievement; it is a demonstration of what British skill can do to make sure that this country remains one of the industrial leaders of the world.

KEY TO THE ATOMIC REACTOR AND STEAM SUPPLY: (1) The reactor core of graphite moderator with rods of Uranium 235, the fuel, suspended in channels. The nuclear fission of the uranium atoms produces great heat. (2) Grid support for the graphite core, which weighs over 1,000 tons. (3) Control rods; these are dropped to shut down the reactor when necessary. (4) Uranium charging tubes. (5) Charging machine. (6) Discharging machine. (7) 8 ft.-thick concrete shielding against radiation. (8) Reactor cooling air duct. (9) Steel inner-shield. (10) Pressure vessel. (11-11) Outlets for the hot carbon dioxide gases heated to enormous temperature by passing through

the core. (12) Hot gas valve. (13) Hot gas inlet to heat exchangers, or 'boilers'. Here the hot gases produce steam in the exchanger tubes. (14) Water feed pipes from turbine condensers. (15) Low pressure steam exchanger tubes. The rising feed water is converted into steam. (16) High pressure steam exchanger tubes. (17) Low and high pressure steam pipes to turbines. (18) Cool gas outlet. (19) Carbon dioxide gas circulating fans. (20) Cool gas valve. (21-21) Cool gas returns to reactor to be heated again. (22) Similar fans and piping for left-hand heat exchanger; there are four of these to one reactor. (23) Reactor cooling air fans. (24) Turbine house.



At home, the electricity finally reaches the familiar fairy-lights at Christmas. These are 'series' wired, so that the 240-volt supply is spread over 12 lamps of 20 volts each.

LITTLE AMERICA 5

This amazing 'village' is one of five similar projects built in the desolate white wastes of Antarctica, by specially-trained crews of a United States Marine Construction Battalion known as 'Seabees'. *Little America 5*, as it is called, is a base camp for teams of scientists participating in the International Geophysical Year. Here, in this sub-surface encampment, everything necessary to life is contained, as well as equipment for all the research scheduled for the I.G.Y. scientists. The specially-designed, box-like buildings were built on the snow level and, within a few weeks, were buried to their flat roofs by the tremendous storms that shriek through the long polar night in that bleak, inhospitable region. Snug below the surface, the population of 76 men can move from building to building through a network of shored snow-tunnels fitted with wire-mesh ceilings to support the drift, whilst above, 100 m.p.h. winds howl, and temperatures drop to minus 70 degrees!

KEY TO NUMBERS: (1) Airstrip. (2) Line of flags marking Airstrip limits. (3) Store for aircraft parts. (4) Aircraft repair shop. (5) 35 ton tractors, known as 'Weasels', used for the innumerable transporting jobs required around the base. (6) Main entrance, and snow ramp to the surface. (7) Surface snow cut away, to show tunnels shored to prevent collapse. (8) The tunnels have wire-mesh ceilings supporting the drift. (9) Surface cut away to show arrangement of tunnels. (10) Dotted lines indicating positions of elaborate tunnel network. (11) Garage. (12) Refrigerator doors fitted in all buildings. (13) Power building, housing Diesel generators which service the base and supply current for running the electronic gear and radio. (14) Photographic laboratory. (15) Geomagnetism. (16) Calibration hut. (17) Inflation centre, where helium is stored; weather balloons are released through the special hatch. (18) Ionosphere and Cosmic-ray laboratories. (19) Quarters; partitioned cubicles are shared by two men. (20) Hospital and Quarters. (21) Supply caves; a natural refrigerator in which food, fuel and spare equipment is stored. Supplies are enough to last all inhabitants for three years. (22) Quarters. (23) Aurora, Airglow, Glaciology and Seismology laboratories.

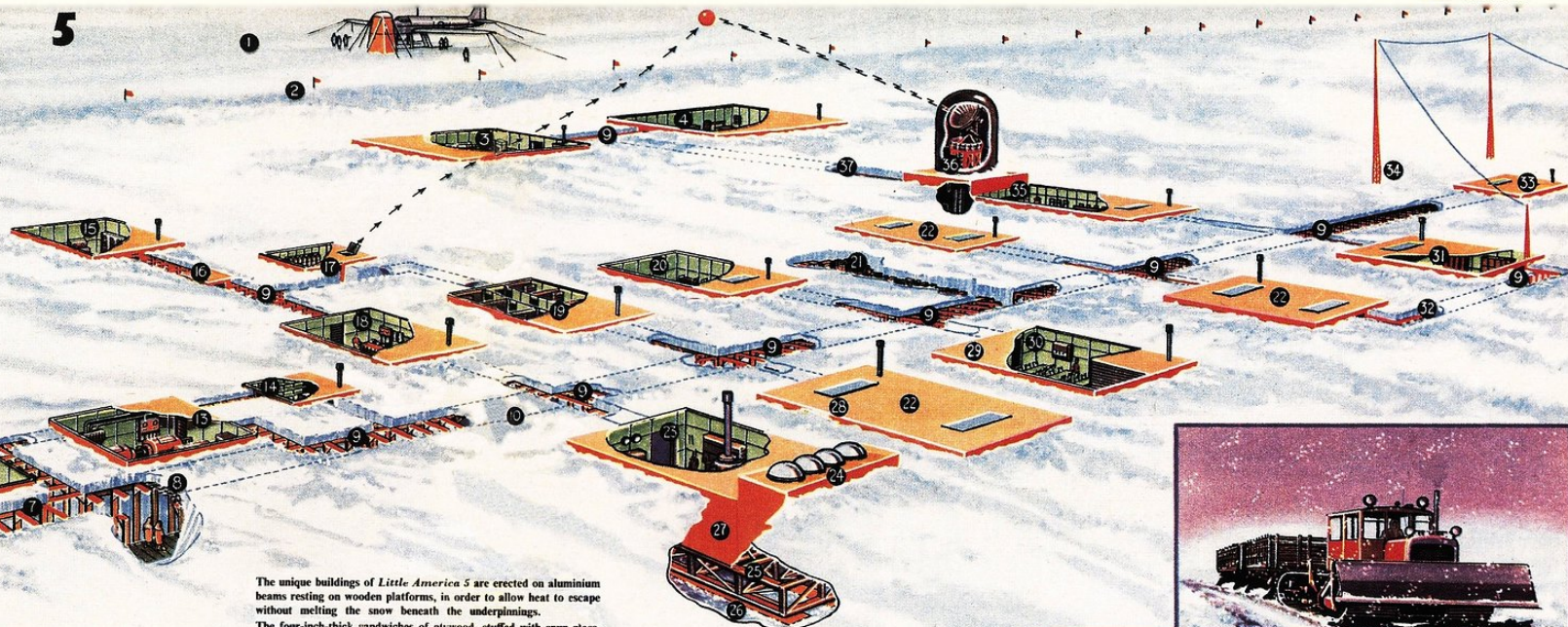
(24) Aurora-viewing dome tower. Sitting in a heated trunk, men can watch ionospheric lights through a row of plastic viewing-domes. Two domes are for visual work and, in the third, an all-sky camera photographs the entire dome of the night sky. A fourth dome, of metal, is fitted with a sliding hatch through which instrumental readings can be made. (25) Buildings are erected on aluminium beams. (26) The whole structure of the buildings rests on wooden snow-shoe footings. (27) The walls of the buildings are composed of panels of plywood. Each panel is a four-inch-thick sandwich of plywood, stuffed with spun-glass. (28) Skylights. (29) The flat roofs of the buildings are constantly wind-swept, and so stay clear of snow. (30) Lounge, Mess and Galley. (31) Communications centre. (32) Rear entrance tunnel. (33) Laundry and Baths. (34) Radio antenna. (35) Meteorology centre. (36) Balloon-tracking antenna-dome. (37) Tunnel to air facility.

The unique buildings of *Little America 5* are erected on aluminium beams resting on wooden platforms, in order to allow heat to escape without melting the snow beneath the underplinnings.

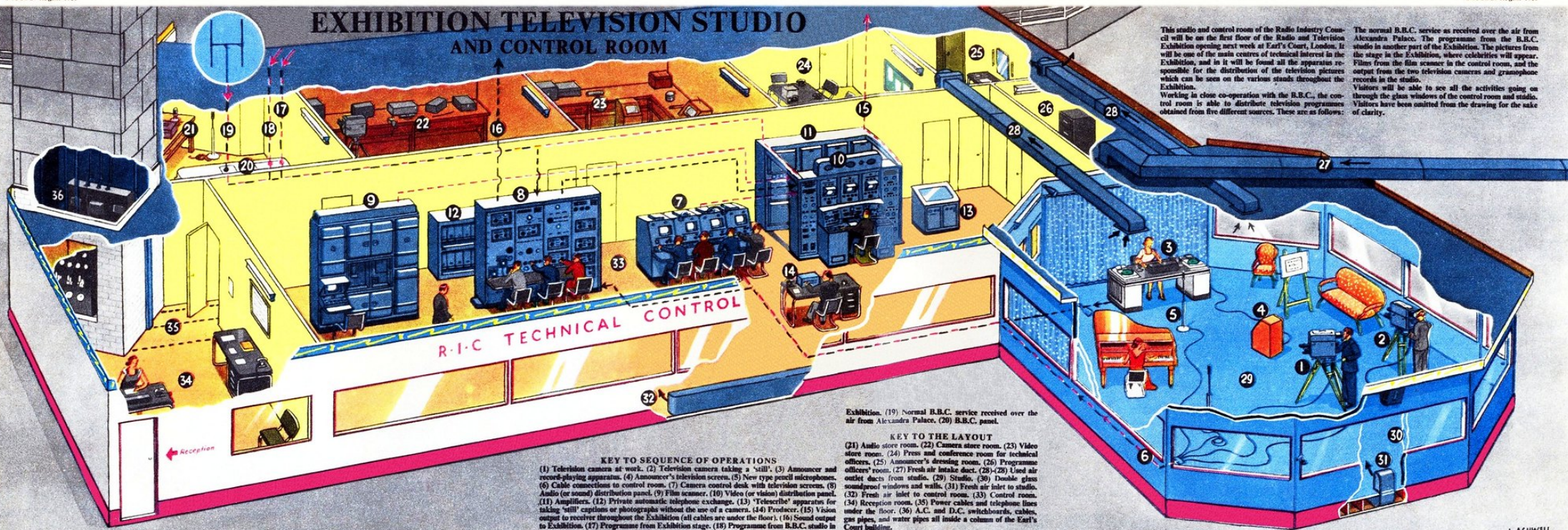
The four-inch-thick sandwiches of plywood, stuffed with spun-glass, which form the floors, roofs and walls of the structures, are lined on the inside walls with sheet aluminium, to reflect heat and light. Plasticized rubber joints seal cracks between panels and assist in insulating the whole building - keeping most of the precious heat in and, at the same time, the bitter cold out.

SLED TRAIN: Big 35 ton tractors, each hauling two 11 ton steel sleds fitted with broad runners, form the largest units ever used in Antarctica. The giant five-foot-wide

tracks of the former act as snow-shoes, exerting a pressure of only four pounds per square inch on the snow, and thus preventing them from sinking below the surface.



EXHIBITION TELEVISION STUDIO AND CONTROL ROOM



This studio and control room of the Radio Industry Council will be on the first floor of the Radio and Television Exhibition opening next week at Earl's Court, London. It will be one of the main centres of technical interest in the Exhibition, and in it will be found all the apparatus responsible for the distribution of the television pictures which can be seen on the various stands throughout the Exhibition.

Working in close co-operation with the B.B.C., the control room is able to distribute television programmes obtained from five different sources. These are as follows:

The normal B.B.C. service as received over the air from Alexandra Palace. The programme from the B.B.C. studio in another part of the Exhibition. The pictures from the stage in the Exhibition, where celebrities will appear. Films from the film scanner in the control room, and the output from the two television cameras and gramophone records in the studio.

Visitors will be able to see all the activities going on through the glass windows of the control room and studio. Visitors have been omitted from the drawing for the sake of clarity.

Exhibition. (19) Normal B.B.C. service received over the air from Alexandra Palace. (20) B.B.C. panel.

KEY TO THE LAYOUT

(21) Audio store room. (22) Camera store room. (23) Video store room. (24) Press and conference room. (25) Announcer's dressing room. (26) Programme officers' room. (27) Fresh air intake duct. (28)-(29) Used air outlet ducts from studio. (29) Studio. (30) Double glass soundproof windows and walls. (31) Fresh air inlet to studio. (32) Fresh air inlet to control room. (33) Control room. (34) Reception room. (35) Power cables and telephone lines under the floor. (36) A.C. and D.C. switchboards, cables, gas pipes, and water pipes all inside a column of the Earl's Court building.

BREAKING THE SPACE BARRIER

Earth satellites that will circle the upper atmosphere of the earth at 18,000 m.p.h. will be in being by 1957, that is official. This will be a step nearer the realm of Dan Dare, the pioneer of spaceships and interplanetary travel. America will send up these "basketballs" by means of multi-stage rockets to a height of about 250 miles. They will weigh 110 pounds and have a diameter of 19½ inches, twice the size of footballs, circling the earth every 90 minutes.

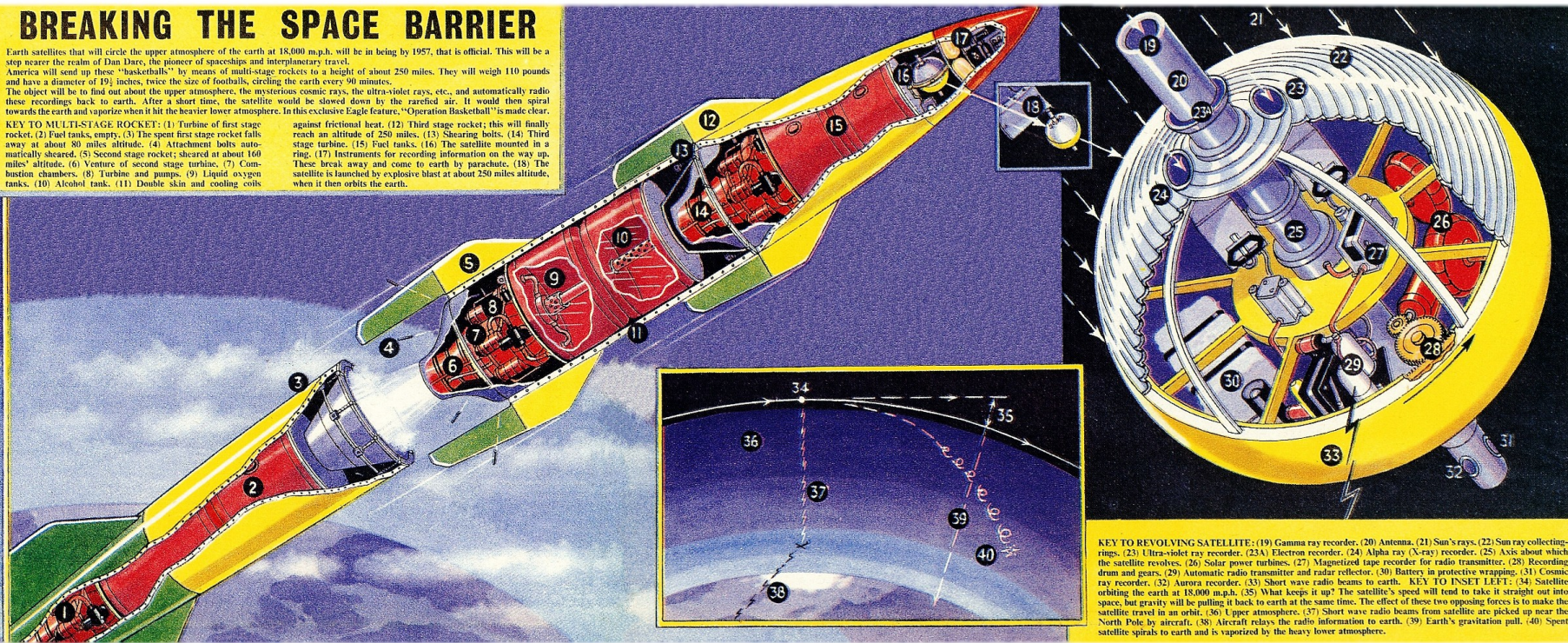
The object will be to find out about the upper atmosphere, the mysterious cosmic rays, the ultra-violet rays, etc., and automatically radio these recordings back to earth. After a short time, the satellite would be slowed down by the rarefied air. It would then spiral towards the earth and vaporize when it hit the heavier lower atmosphere. In this exclusive Eagle feature, "Operation Basketball" is made clear.

KEY TO MULTI-STAGE ROCKET: (1) Turbine of first stage rocket. (2) Fuel tanks, empty. (3) The spent first stage rocket falls away at about 80 miles altitude. (4) Attachment bolts automatically sheared. (5) Second stage rocket; sheared at about 160 miles' altitude. (6) Venture of second stage turbine. (7) Combustion chambers. (8) Turbine and pumps. (9) Liquid oxygen tanks. (10) Alcohol tank. (11) Double skin and cooling coils

against frictional heat. (12) Third stage rocket; this will finally reach an altitude of 250 miles. (13) Shearing bolts. (14) Third stage turbine. (15) Fuel tanks. (16) The satellite mounted in a ring. (17) Instruments for recording information on the way up. These break away and come to earth by parachute. (18) The satellite is launched by explosive blast at about 250 miles altitude, when it then orbits the earth.

KEY TO THE EARTH'S ATMOSPHERIC BELT

- A. Mount Everest, 29,003 feet.
- B. The Troposphere (next to earth) and the Tropopause.
- C. The Stratosphere.
- D. Ordinary wireless waves are bent to earth by the Heaviside layer. Beam wireless waves are bent by the Appleton layer at about 170 miles' altitude.
- E. The Ionosphere.
- F. Limit of visible meteors.
- G. Streamers of Aurora from here upwards.
- H. The light of sky disappears into inky darkness beyond.
- J. Satellite launched by rocket into outer space outside the atmospheric belt.
- K. Outer space.
- L. Electrons colliding with atoms of the upper atmosphere, resulting in cosmic rays.



KEY TO REVOLVING SATELLITE: (19) Gamma ray recorder. (20) Antenna. (21) Sun's rays. (22) Sun ray collecting rings. (23) Ultra-violet ray recorder. (23A) Electron recorder. (24) Alpha ray (X-ray) recorder. (25) Axis about which the satellite revolves. (26) Solar power turbines. (27) Magnetized tape recorder for radio transmitter. (28) Recording drum and gears. (29) Automatic radio transmitter and radar reflector. (30) Battery in protective wrapping. (31) Cosmic ray recorder. (32) Aurora recorder. (33) Short wave radio beams to earth. **KEY TO INSET LEFT:** (34) Satellite orbiting the earth at 18,000 m.p.h. (35) What keeps it up? The satellite's speed will tend to take it straight out into space, but gravity will be pulling it back to earth at the same time. The effect of these two opposing forces is to make the satellite travel in an orbit. (36) Upper atmosphere. (37) Short wave radio beams from satellite are picked up near the North Pole by aircraft. (38) Aircraft relays the radio information to earth. (39) Earth's gravitation pull. (40) Spent satellite spirals to earth and is vaporized by the heavy lower atmosphere.

THE ANTARCTIC EXPEDITION SUPPLY SHIP

"Full to the brim", or "loaded to the bulwarks" in seafaring language! This is how the 849 ton Antarctic supply ship *Theron* pushes her way through the drift and pack-ice in the Weddell Sea, in an endeavour to establish the first supply base at Vahsel Bay, on the shores of the Continent of Antarctica.

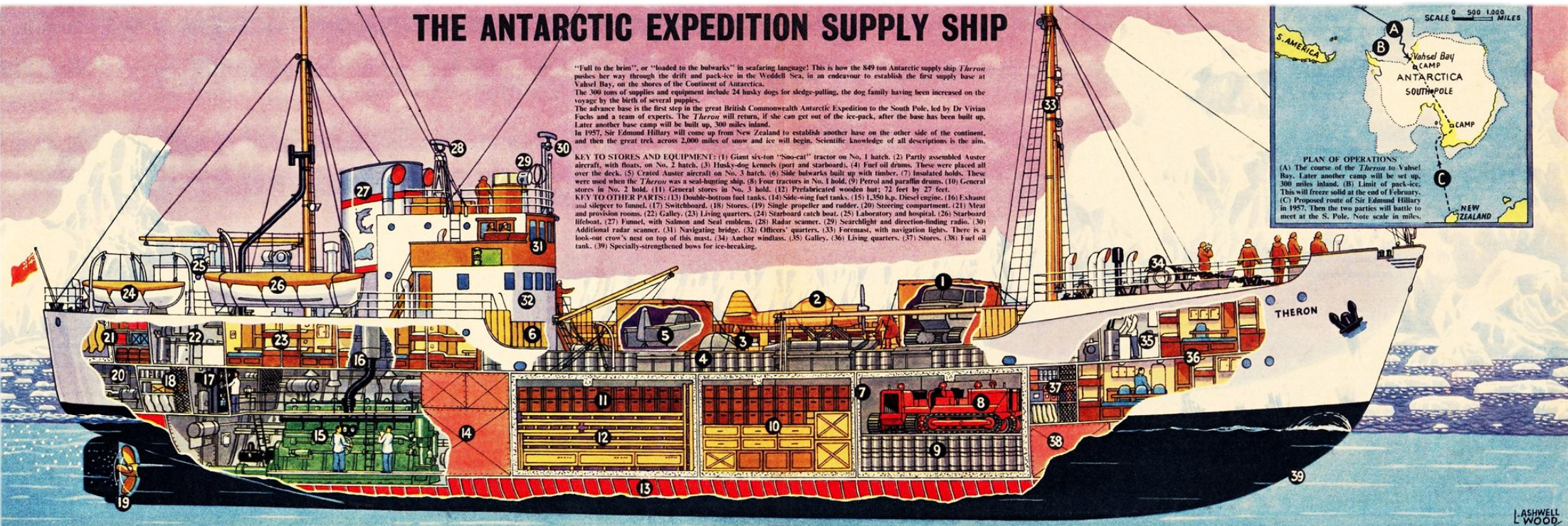
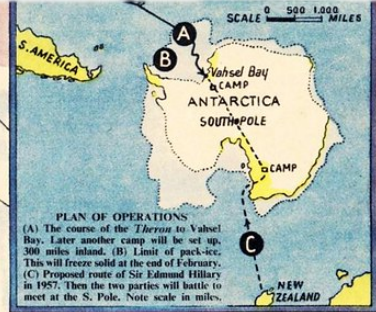
The 300 tons of supplies and equipment include 24 husky dogs for sledge-pulling, the dog family having been increased on the voyage by the birth of several puppies.

The advance base is the first step in the great British Commonwealth Antarctic Expedition to the South Pole, led by Dr Vivian Fuchs and a team of experts. The *Theron* will return, if she can get out of the ice-pack, after the base has been built up. Later another base camp will be built up, 300 miles inland.

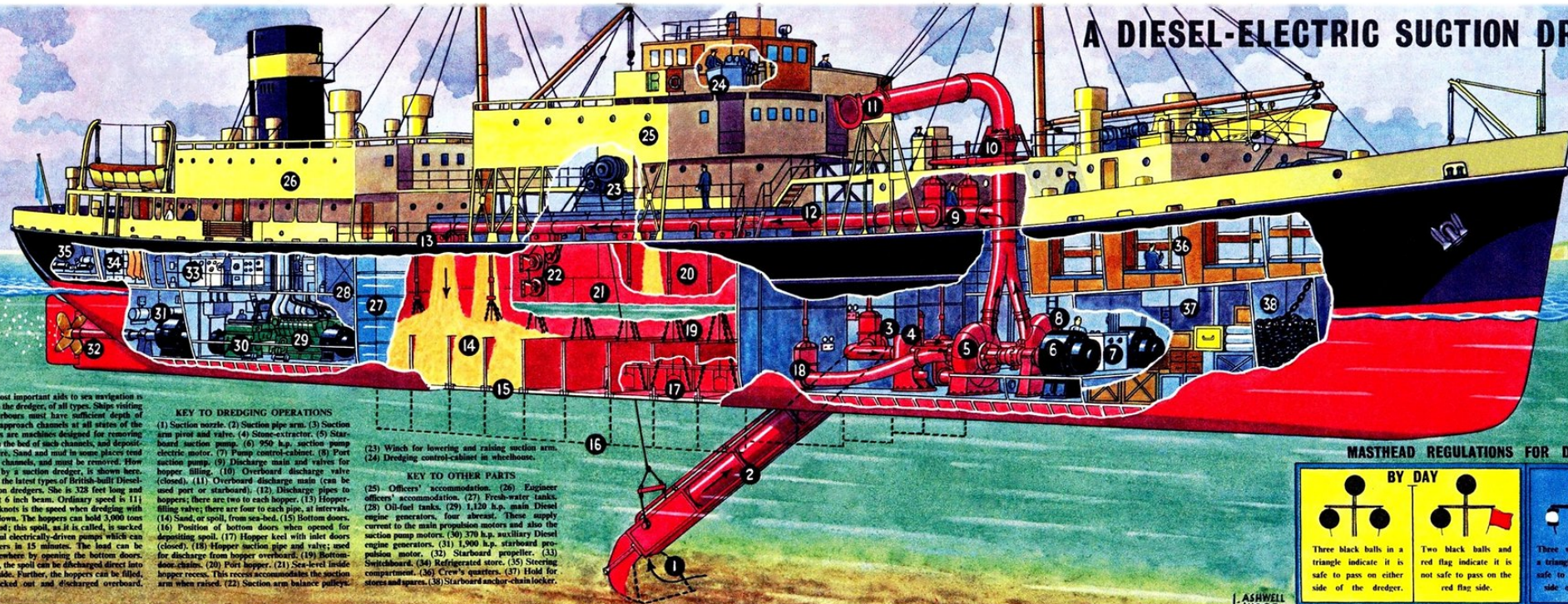
In 1957, Sir Edmund Hillary will come up from New Zealand to establish another base on the other side of the continent, and then the great trek across 2,000 miles of snow and ice will begin. Scientific knowledge of all descriptions is the aim.

KEY TO STORES AND EQUIPMENT: (1) Giant six-ton "Sno-cat" tractor on No. 1 hatch. (2) Partly assembled Auster aircraft, with floats, on No. 2 hatch. (3) Husky-dog kennels (port and starboard). (4) Fuel oil drums. These were placed all over the deck. (5) Crated Auster aircraft on No. 3 hatch. (6) Side bulwarks built up with timber. (7) Insulated holds. These were used when the *Theron* was a seal-hunting ship. (8) Four tractors in No. 1 hold. (9) Petrol and paraffin drums. (10) General stores in No. 2 hold. (11) General stores in No. 3 hold. (12) Prefabricated wooden hut: 72 feet by 27 feet.

KEY TO OTHER PARTS: (13) Double-bottom fuel tanks. (14) Side-wing fuel tanks. (15) 1,350 h.p. Diesel engine. (16) Exhaust and silencer to funnel. (17) Switchboard. (18) Stores. (19) Single propeller and rudder. (20) Steering compartment. (21) Meat and provision rooms. (22) Galley. (23) Living quarters. (24) Starboard catch boat. (25) Laboratory and hospital. (26) Starboard lifeboat. (27) Funnel, with Salmon and Seal emblem. (28) Radar scanner. (29) Searchlight and direction-finding radio. (30) Additional radar scanner. (31) Navigating bridge. (32) Officers' quarters. (33) Foremast, with navigation lights. There is a look-out crow's nest on top of this mast. (34) Anchor windlass. (35) Galley. (36) Living quarters. (37) Stores. (38) Fuel oil tank. (39) Specially-strengthened bows for ice-breaking.



A DIESEL-ELECTRIC SUCTION DREDGER



One of the most important aids to sea navigation is to be found in the dredger, of all types. Ships visiting ports and harbours must have sufficient depth of water in the approach channels at all states of the tide. Dredgers are machines designed for removing material from the bed of such channels, and depositing it elsewhere. Sand and mud in some places tend to silt up the channels, and must be removed. How this is done, by a suction dredger, is shown here. This is one of the latest types of British-built Diesel-electric suction dredgers. She is 328 feet long and has a 53 foot 6 inch beam. Ordinary speed is 11½ knots, but 2 knots is the speed when dredging with suction arm down. The hoppers can hold 3,000 tons of sand or mud; this spoil, as it is called, is sucked up by powerful electrically-driven pumps which can fill the hoppers in 15 minutes. The load can be deposited elsewhere by opening the bottom doors. Alternatively, the spoil can be discharged direct into barges alongside. Further, the hoppers can be filled, and then sucked out and discharged overboard.

KEY TO DREDGING OPERATIONS

(1) Suction nozzle. (2) Suction pipe arm. (3) Suction arm pivot and valve. (4) Stone-extractor. (5) Starboard suction pump. (6) 950 h.p. suction pump electric motor. (7) Pump control-cabinet. (8) Port suction pump. (9) Discharge main and valves for hopper filling. (10) Overboard discharge valve (closed). (11) Overboard discharge main (can be used port or starboard). (12) Discharge pipes to hoppers; there are two to each hopper. (13) Hopper-filling valve; there are four to each pipe, at intervals. (14) Sand, or spoil, from sea-bed. (15) Bottom doors. (16) Position of bottom doors when opened for depositing spoil. (17) Hopper keel with inlet doors (closed). (18) Hopper suction pipe and valve; used for discharge from hopper overboard. (19) Bottom-door-chains. (20) Port hopper. (21) Sea-level inside hopper recess. This recess accommodates the suction arm when raised. (22) Suction arm balance pulleys.

(23) Winch for lowering and raising suction arm. (24) Dredging control-cabinet in wheelhouse.

KEY TO OTHER PARTS

(25) Officers' accommodation. (26) Engineer officers' accommodation. (27) Fresh-water tanks. (28) Oil-fuel tanks. (29) 1,120 h.p. main Diesel engine generators, four abreast. These supply current to the main propulsion motors and also the suction pump motors. (30) 370 h.p. auxiliary Diesel engine generators. (31) 1,900 h.p. starboard propulsion motor. (32) Starboard propeller. (33) Switchboard. (34) Refrigerated store. (35) Steering compartment. (36) Crew's quarters. (37) Hold for stores and spares. (38) Starboard anchor-chain locker.

MASTHEAD REGULATIONS FOR DREDGERS AT WORK

BY DAY



Three black balls in a triangle indicate it is safe to pass on either side of the dredger.



Two black balls and red flag indicate it is not safe to pass on the red flag side.

BY NIGHT



Three white lights in a triangle indicate it is safe to pass on either side of the vessel.



Two white lights and one red indicate it is not safe to pass on the red light side.

L. ASHVELL WOOD

BRITISH RAILWAYS CLASS "7" EXPRESS

This is one of the standard class "7" 4-6-2 locomotives, No. 70038, named ROBIN HOOD, shown here on a vacuum-operated turntable. This drawing is different from the previous ones of some of the British Railways "family" of locomotives, in that here we show more of "what's underneath", thus giving a complete insight into locomotive working.

KEY TO WATER FEED SYSTEM (Shown in Green)

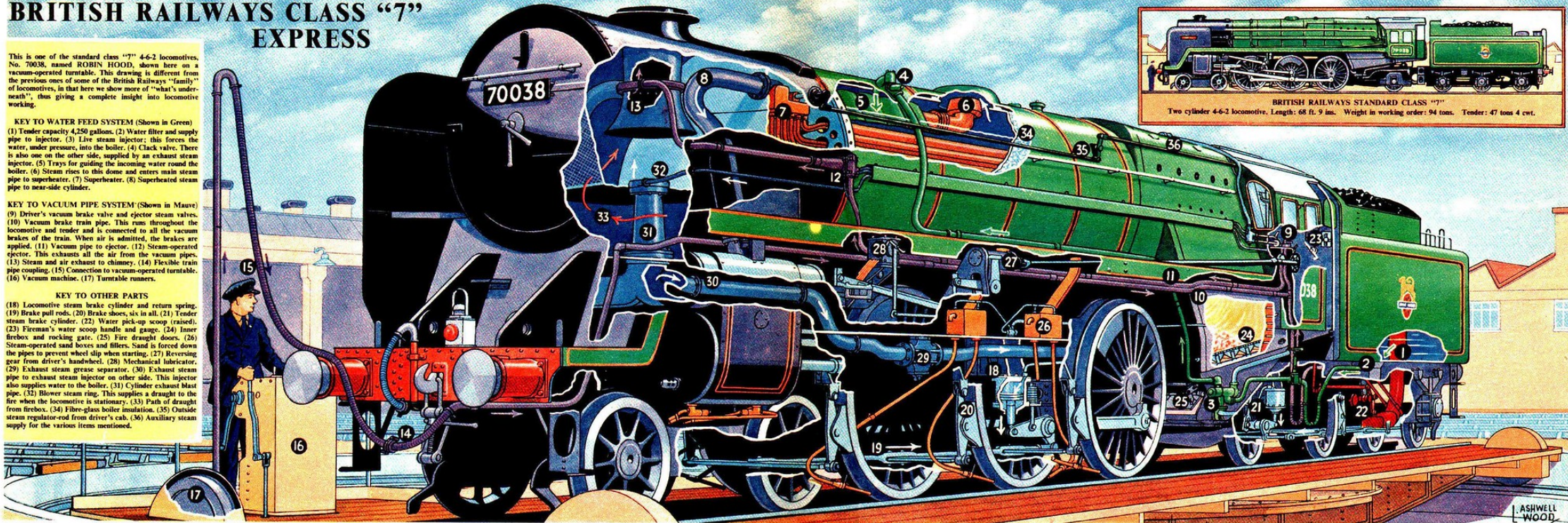
(1) Tender capacity 4,250 gallons. (2) Water filter and supply pipe to injector. (3) Live steam injector; this forces the water, under pressure, into the boiler. (4) Clack valve. There is also one on the other side, supplied by an exhaust steam injector. (5) Trays for guiding the incoming water round the boiler. (6) Steam rises to this dome and enters main steam pipe to superheater. (7) Superheater. (8) Superheated steam pipe to near-side cylinder.

KEY TO VACUUM PIPE SYSTEM (Shown in Mauve)

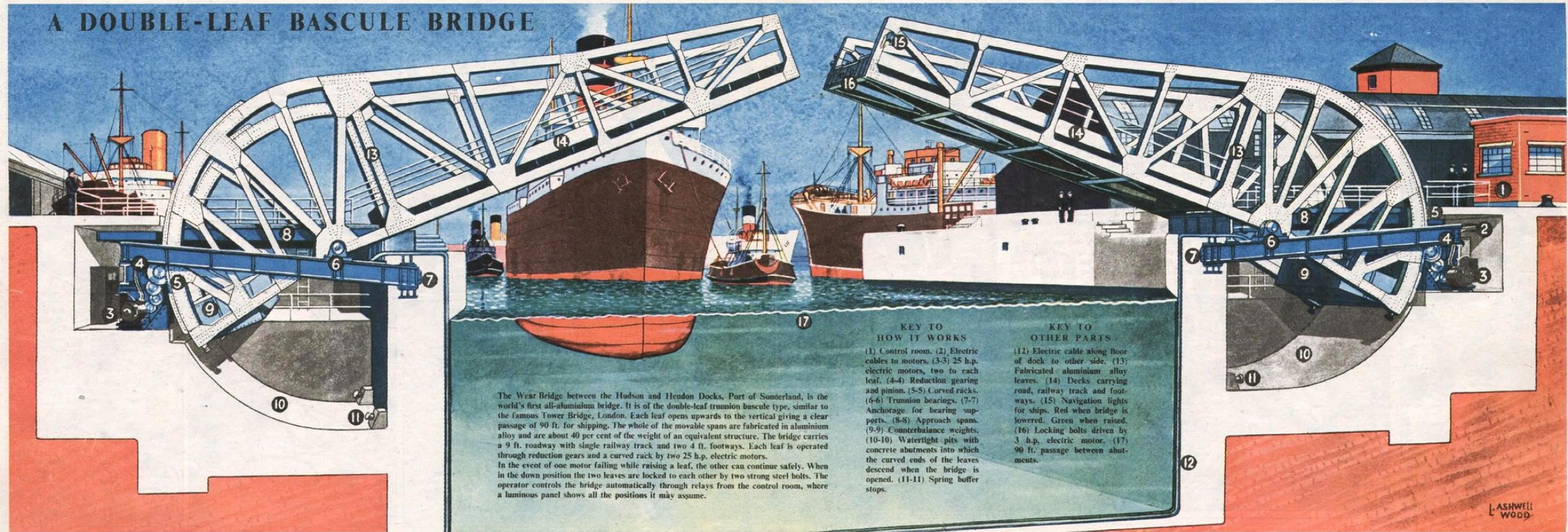
(9) Driver's vacuum brake valve and ejector steam valves. (10) Vacuum brake train pipe. This runs throughout the locomotive and tender and is connected to all the vacuum brakes of the train. When air is admitted, the brakes are applied. (11) Vacuum pipe to ejector. (12) Steam-operated ejector. This exhausts all the air from the vacuum pipes. (13) Steam and air exhaust to chimney. (14) Flexible train pipe coupling. (15) Connection to vacuum-operated turntable. (16) Vacuum machine. (17) Turntable runners.

KEY TO OTHER PARTS

(18) Locomotive steam brake cylinder and return spring. (19) Brake pull rods. (20) Brake shoes, six in all. (21) Tender steam brake cylinder. (22) Water pick-up scoop (raised). (23) Fireman's water scoop handle and gauge. (24) Inner firebox and rocking gate. (25) Fire draught doors. (26) Steam-operated sand boxes and filters. Sand is forced down the pipes to prevent wheel slip when starting. (27) Reversing gear from driver's handwheel. (28) Mechanical lubricator. (29) Exhaust steam grease separator. (30) Exhaust steam pipe to exhaust steam injector on other side. This injector also supplies water to the boiler. (31) Cylinder exhaust blast pipe. (32) Blower steam ring. This supplies a draught to the fire when the locomotive is stationary. (33) Path of draught from firebox. (34) Fibre-glass boiler insulation. (35) Outside steam regulator-rod from driver's cab. (36) Auxiliary steam supply for the various items mentioned.



A DOUBLE-LEAF BASCULE BRIDGE



The Wear Bridge between the Hudson and Hendon Docks, Port of Sunderland, is the world's first all-aluminium bridge. It is of the double-leaf trunnion bascule type, similar to the famous Tower Bridge, London. Each leaf opens upwards to the vertical giving a clear passage of 90 ft. for shipping. The whole of the movable spans are fabricated in aluminium alloy and are about 40 per cent of the weight of an equivalent structure. The bridge carries a 9 ft. roadway with single railway track and two 4 ft. footways. Each leaf is operated through reduction gears and a curved rack by two 25 h.p. electric motors. In the event of one motor failing while raising a leaf, the other can continue safely. When in the down position the two leaves are locked to each other by two strong steel bolts. The operator controls the bridge automatically through relays from the control room, where a luminous panel shows all the positions it may assume.

KEY TO HOW IT WORKS

(1) Control room. (2) Electric cables to motors. (3-3) 25 h.p. electric motors, two to each leaf. (4-4) Reduction gearing and pinion. (5-5) Curved racks. (6-6) Trunnion bearings. (7-7) Anchorage for bearing supports. (8-8) Approach spans. (9-9) Counterbalance weights. (10-10) Watertight pits with concrete abutments into which the curved ends of the leaves descend when the bridge is opened. (11-11) Spring buffer stops.

KEY TO OTHER PARTS

(12) Electric cable along floor of dock to other side. (13) Fabricated aluminium alloy leaves. (14) Decks carrying road, railway track and footways. (15) Navigation lights for ships. Red when bridge is lowered. Green when raised. (16) Locking bolts driven by 3 h.p. electric motor. (17) 90 ft. passage between abutments.

THE SUPERMARINE ATTACKER

The first jet aircraft off the flight deck of the new aircraft carrier H.M.S. Eagle, the Vickers-Armstrong Supermarine Attacker, represents the latest conception of naval fighters. It is powered by a Rolls-Royce "Nene" jet engine, giving a static thrust of 5,000 pounds, which is equivalent to 15,000 h.p. at a speed of 600 m.p.h.

No. 800 Squadron of H.M.S. Eagle, which uses Attackers, is the first operational naval unit to be equipped with jet aircraft.

KEY TO SEQUENCE OF OPERATIONS

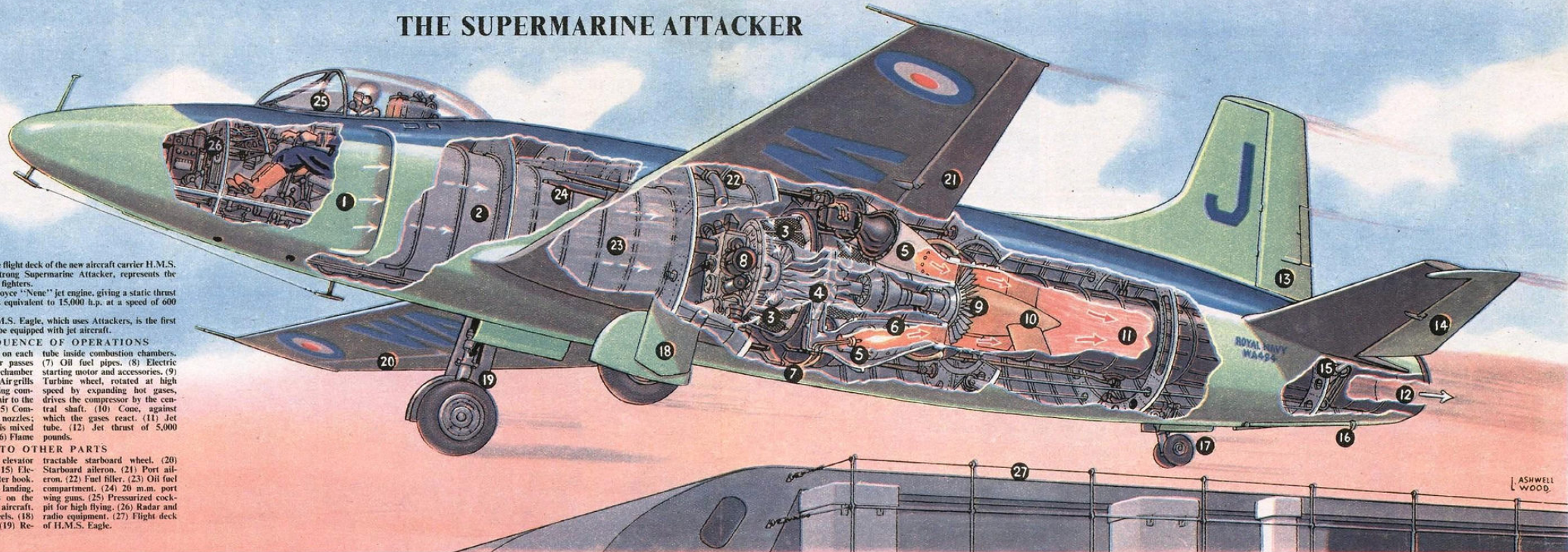
(1) Air intake ducts, one on each side of fuselage. (2) Air passes through ducts to plenum chamber and thence to engine. (3-3) Air grills to compressor. (4) Rotating compressor, which forces the air to the combustion chambers. (5-5) Combustion chambers with fuel nozzles; here the compressed air is mixed with oil fuel and ignited. (6) Flame

tube inside combustion chambers. (7) Oil fuel pipes. (8) Electric starting motor and accessories. (9) Turbine wheel, rotated at high speed by expanding hot gases, drives the compressor by the central shaft. (10) Cone, against which the gases react. (11) Jet tube. (12) Jet thrust of 5,000 pounds.

KEY TO OTHER PARTS

(13) Rudder. (14) Port elevator raised (also starboard). (15) Elevator controls. (16) Arrestor hook. Lowered when aircraft is landing, and connects with wires on the flight deck to retard the aircraft. (17) Retractable tail wheels. (18) Retractable port wheel. (19) Re-

tractable starboard wheel. (20) Starboard aileron. (21) Port aileron. (22) Fuel filler. (23) Oil fuel compartment. (24) 20 m.m. port wing guns. (25) Pressurized cockpit for high flying. (26) Radar and radio equipment. (27) Flight deck of H.M.S. Eagle.



In the history of aviation, a certain select few aircraft have achieved lasting fame, because of the innovations they introduced or first utilized in practical form. The MESSERSCHMITT 262 is one of these outstanding machines, being the first to achieve operational status using the turbojet.

Errors on the part of Germany's war-leaders slowed down its development and production, robbing the aircraft of its chances to become a vital factor in World War II. It was a formidable aircraft, of inspired design with great possibilities, and holds a unique position in the annals of aerial warfare. Some authorities are even of the opinion that it might have prolonged the war, and changed the entire course of history, had its development not been retarded.

Many versions were built; some were fighters, as shown in our drawing, and others fighter-bombers. It is estimated that 1,294 machines of the ME.262 series were constructed, but of these probably not more than 100 participated in the latter period of the air war.

KEY TO NUMBERS

(1) Camera gun. (2) Two port-side 30 m.m. Mk. 108 cannon. Another pair is fitted on the starboard side. (3) Nosewheel jack. (4) Port drop-tank (or bomb) pylon. (5) 66 Imp. gallon drop-tank. Alternatively, one 550lb. bomb could be carried by each pylon. (6) Starboard pylon and drop-tank. (7) Ejector chutes for spent shell-cases and links. (8) Compressed-air bottles. (9) Forward main armoured fuel-tank; capacity, 198 Imp. gallons. (10) Filler cap. (11) 90 m.m. armour-glass windshield. (12) Starboard motor nacelle. (13) Flaps. (14) Frise-type ailerons fitted with Flettner-type geared trim-tabs. (15) Frise-type ailerons fitted with trim tabs adjustable on the ground only. (16) Starboard navigation light. (17) Port navigation light. (18) Pitot head. (19) Automatic leading-edge slots. (20) Riedel 4-cylinder two-stroke starter-motor housing. (21) Port Junkers Jumo 109-004B-2 eight-stage axial-flow gas-turbine motor. (22) Slot control rod. (23) Mainplane spar. (24) Port mainwheel retracted into well. (25) 37.4 Imp. gallon capacity fuel-tank. (26) Cockpit shell. (27) Ejector seat. (28) Armour-plate shield, protecting pilot from rear. (29) Rear main armoured fuel-tank; capacity, 198 Imp. gallons. (30) Control rods for rudder and elevators. (31) Self-sealing fuel-tank; capacity, 132 Imp. gallons. (32) Ring antenna (friend-foe identification). (33) Elevator-incidence mechanism housing. (34) Rear navigation light. (35) Flettner-type Servo tab. (36) Mass-balanced elevator. (37) Mass-balanced rudder. (38) Flettner-type geared tab; also used for trimming.

MESSERSCHMITT ME.262A-2a



A FAMOUS BRITISH BOMBER

The last of the *Lancasters*—probably the best-known of all the last-war bombers—has been withdrawn from service in R.A.F. Bomber Command. As a tribute to the brave men of the R.A.F. who flew these magnificent machines, we think it fitting to feature here the famous *Avro Lancaster* in its wartime colouring. Without doubt the finest and fastest bomber in the world in its time, the *Lancaster* was powered by four Rolls-Royce Merlin XX engines of 1,280 h.p. each, giving a top speed of 300 m.p.h.

It had an all up take-off weight, fully loaded, of 27 tons, which included 8 tons of bombs.

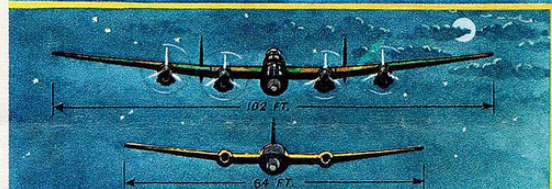
The normal crew was six and the armament consisted of ten Browning .303 machine guns in hydraulically-operated turrets. 50,000 parts went into its construction (not counting nuts and bolts) and altogether 7,366 *Lancasters* were built. The *Lancaster* ranks in fame with the *Hurricane* and the *Spitfire*.

KEY TO PARTS (Starting from the nose)

(1) Bomb-aimer's window (2) Navigator and Bomb-aimer. (3) Nose gun-turret. (4) Bomb-aimer's peep-hole into bomb bay. (5) Bomb bay (doors open). (6) Captain. (7) Second pilot. (8) Observation window blister. (9) Navigator's seat and table. (10) Radio-operator and gunner. (11) Astrodome. (12) Crew's rest bunk. (13) Inner starboard petrol tank (580 gallons). (14) Exhaust flame guard of inner starboard Rolls-Royce

Merlin XX engine. (15) Starboard undercarriage wheel (retracted). (16) Middle starboard petrol tank (383 gallons). (17) Outer starboard Rolls-Royce Merlin XX twelve-cylinder engine of 1,280 h.p. (18) De Havilland constant speed propeller. (19) Oil and cooling radiator. (20) Carburettor air intake. (21) Fire-proof wall. (22) Oil tank. (23) Outer starboard petrol tank (114 gallons). Similar tanks are in the port wing. (24) Star-

board navigation and formation-keeping lights. (25) Mid lower gun-turret. (26) Night flares. (27) Tail gun ammunition magazine. (28) Mid lower gun ammunition magazine. (29) Ammunition runways to tail gun. (30) Mid upper gun-turret. (31) Rear door and vacuum flasks. (32) Fixed tail wheel with castor action. (33) Folding doors to tail gun. (34) Tail gun-turret (4 guns). (35)-(35) Twin tail fins and rudders.



The *Lancaster* compared with the smaller, nippier *Canberra* jet, which has taken its place in R.A.F. Bomber Command. The *Lancaster*'s top speed was 300 m.p.h. The *Canberra*'s is 480 m.p.h.

THE EMPIRE'S MIGHTIEST BATTLESHIP

Britain's largest, strongest and newest battleship, H.M.S. "Vanguard", 42,500 tons, is also one of the largest in the world, the other being the United States "Iowa". The "Vanguard" is 814 feet long with a width of 107 feet. Her 8 Admiralty-type boilers supply steam to the four turbines which develop 130,000 h.p. and drives the ship at 28 knots. Her armament consists of eight 15 in. guns, sixteen 5.25 high angle guns, seventy-one 40 mm. anti-aircraft guns and four 3-pounder saluting guns. Full crew 2,000 men. This is the second drawing of our series of ships of the Royal Navy and the vessel is shown wearing the flag of a Rear-Admiral.

KEY TO NUMBERS ABOVE DECK

- (1) Anchor cables and capstans. (2) Breakwaters (three). (3) Forward "A" and "B" turrets of two 15 in. guns each. (4) Two 40 mm. guns. (5) Single 40 mm. gun. (6) Upper navigating bridge and forward superstructure of sea cabins, etc. (7) Fire director towers. (8) Foremast. (9) Fire director towers for 40 mm. batteries. (10) Batteries of six each, 40 mm. anti-aircraft guns. (11) 3-pounder saluting guns. (12) Forward port 5.25 in. guns. (13) Boat cranes. (14) Various boats, whalers and launches. (15) Galley. (16) After starboard 5.25 in. guns. (17) Main mast. (18) Fire director towers for 5.25 in. guns. (19) Fire director tower for 15 in. guns. (20) After "Y" and "X" turrets of two 15 in. guns each.

KEY TO NUMBERS BELOW DECK

- (21) Balanced rudder. (22) Port propellers. (23) Officers' cabins. (24) 16 in. thick armour belt protecting entire length of engines, boilers, magazines, etc. (25) Armoured main deck. (26) Magazines. (27) Stores and oil fuel tanks. (28) Cinema. (29) "X" engine room. (30) "X" boiler room. (31) Dining hall. (32) "A" engine room. (33) "A" boiler room. (34) Fire computing and transmitting rooms (the "brains" of the ship). (35) Various stores. (36) Crew spaces.



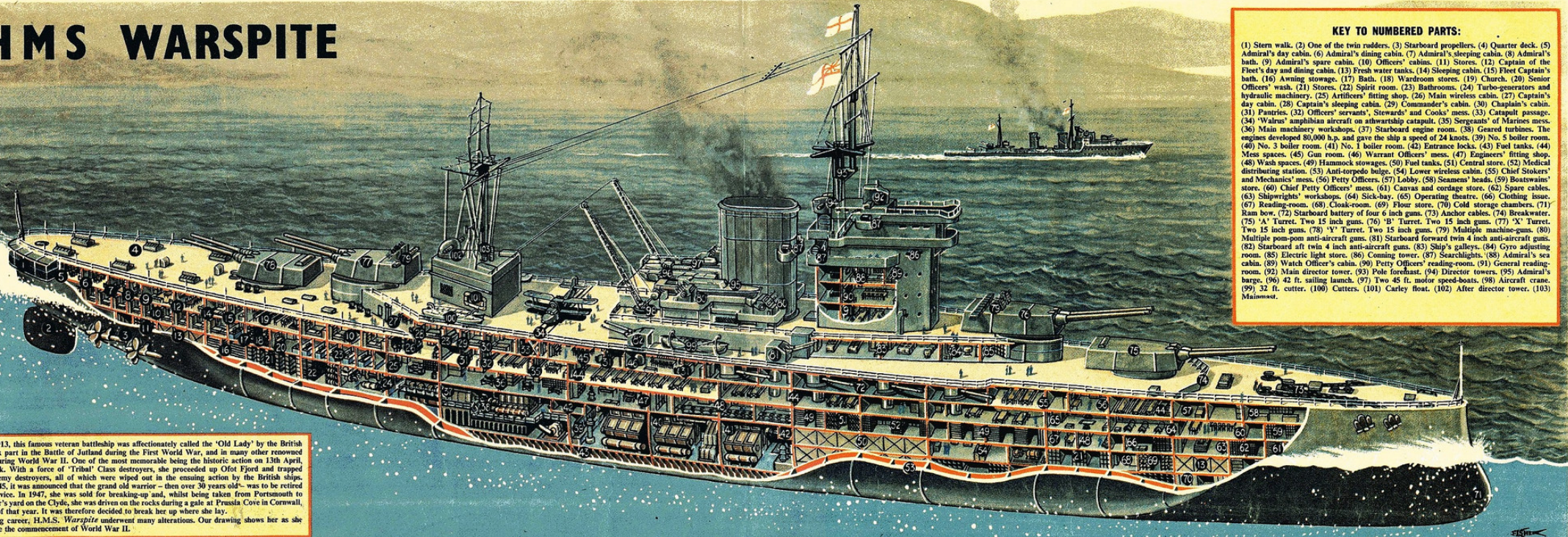
Length 814 ft. 6 in.



Width 107 ft. 6 in.

ASINELL
WOOD

HMS WARSPITE



KEY TO NUMBERED PARTS:

(1) Stern walk. (2) One of the twin rudders. (3) Starboard propellers. (4) Quarter deck. (5) Admiral's day cabin. (6) Admiral's dining cabin. (7) Admiral's sleeping cabin. (8) Admiral's bath. (9) Admiral's spare cabin. (10) Officers' cabins. (11) Stores. (12) Captain of the Fleet's day and dining cabin. (13) Fresh water tanks. (14) Sleeping cabin. (15) Fleet Captain's bath. (16) Awning stowage. (17) Bath. (18) Wardroom stores. (19) Church. (20) Senior Officers' wash. (21) Stores. (22) Spirit room. (23) Bathrooms. (24) Turbo-generators and hydraulic machinery. (25) Artificers' fitting shop. (26) Main wireless cabin. (27) Captain's day cabin. (28) Captain's sleeping cabin. (29) Commander's cabin. (30) Chaplain's cabin. (31) Pantries. (32) Officers' servants', Stewards' and Cooks' mess. (33) Catapult passage. (34) 'Walrus' amphibian aircraft on athwartship catapult. (35) Sergeants' of Marines mess. (36) Main machinery workshops. (37) Starboard engine room. (38) Geared turbines. The engines developed 80,000 h.p. and gave the ship a speed of 24 knots. (39) No. 5 boiler room. (40) No. 3 boiler room. (41) No. 1 boiler room. (42) Entrance locks. (43) Fuel tanks. (44) Mess spaces. (45) Gun room. (46) Warrant Officers' mess. (47) Engineers' fitting shop. (48) Wash spaces. (49) Hammock stowages. (50) Fuel tanks. (51) Central store. (52) Medical distributing station. (53) Anti-torpedo bulge. (54) Lower wireless cabin. (55) Chief Stokers' and Mechanics' mess. (56) Petty Officers'. (57) Lobby. (58) Seamen's heads. (59) Boatswains' store. (60) Chief Petty Officers' mess. (61) Canvas and cordage store. (62) Spare cables. (63) Shipwrights' workshops. (64) Sick-bay. (65) Operating theatre. (66) Clothing issue. (67) Reading-room. (68) Cloak-room. (69) Flour store. (70) Cold storage chambers. (71) Ram bow. (72) Starboard battery of four 6 inch guns. (73) Anchor cables. (74) Breakwater. (75) 'A' Turret. Two 15 inch guns. (76) 'B' Turret. Two 15 inch guns. (77) 'X' Turret. Two 15 inch guns. (78) 'Y' Turret. Two 15 inch guns. (79) Multiple machine-guns. (80) Multiple pom-pom anti-aircraft guns. (81) Starboard forward twin 4 inch anti-aircraft guns. (82) Starboard aft twin 4 inch anti-aircraft guns. (83) Ship's galleys. (84) Gyro adjusting room. (85) Electric light store. (86) Conning tower. (87) Searchlights. (88) Admiral's sea cabin. (89) Watch Officer's cabin. (90) Petty Officers' reading-room. (91) General reading-room. (92) Main director tower. (93) Pole foremast. (94) Director towers. (95) Admiral's barge. (96) 42 ft. sailing launch. (97) Two 45 ft. motor speed-boats. (98) Aircraft crane. (99) 32 ft. cutter. (100) Cutters. (101) Carley float. (102) After director tower. (103) Mainmast.

Launched in 1913, this famous veteran battleship was affectionately called the 'Old Lady' by the British Navy. She took part in the Battle of Jutland during the First World War, and in many other renowned engagements during World War II. One of the most memorable being the historic action on 13th April, 1940, at Narvik. With a force of 'Tribal' Class destroyers, she proceeded up Ofot Fjord and trapped seven large enemy destroyers, all of which were wiped out in the ensuing action by the British ships. In October, 1945, it was announced that the grand old warrior - then over 30 years old - was to be retired from active service. In 1947, she was sold for breaking-up and, whilst being taken from Portsmouth to the ship-breaker's yard on the Clyde, she was driven on the rocks during a gale at Prussia Cove in Cornwall, on 23rd April of that year. It was therefore decided to break her up where she lay. During her long career, H.M.S. Warspite underwent many alterations. Our drawing shows her as she appeared before the commencement of World War II.

THE ROYAL SHIP TO CANADA

On September 25th, Their Royal Highnesses Princess Elizabeth and the Duke of Edinburgh are due to leave Liverpool in the Canadian Pacific liner "Empress of France" for Quebec, whence they will start their tour of the Dominion. A special suite on "A" deck has been reserved for them and their entourage. This fine liner, depicted here, has a gross weight of 20,400 tons, and is 601 ft. long. Her geared turbine engines, driving two propellers, give her a speed of 18 knots. This drawing was made with the kind co-operation and assistance of the Canadian Pacific Railways.

KEY TO FEATURES

- (1) The Royal Suite. (2) Duke of Edinburgh's staff cabin. (3) Princess Elizabeth's staff cabin. (4) Princess Elizabeth's Standard from mainmast. (5) Radar scanner and cabin. (6) Wheelhouse and navigating bridge. (7) Radio lead-in. (8) Lift machinery. (9) Funnel uptakes from aft boiler room. (10) Engine room hatch and ventilators. (11) Cinema in the Empress room on the promenade deck. (12) First class lounge. (13) Lift and stairs to all decks. (14) Long Gallery leading to Cocktail Bar under bridge. (15) Enclosed Promenade deck. (16) Officers' cabins. (17) Bath rooms. (18) First class cabins. (19) Crew and stewards' quarters. (20) Cargo holds. (21) Forward boiler room (4 boilers). (22) Oil fuel tanks. (23) Aft boiler room (4 boilers). (24) First class dining room. (25) Captain's table, at which Princess Elizabeth and the Duke of Edinburgh may occasionally dine. (26) Main kitchens serving both dining rooms. (27) Geared turbine engine rooms. (28) Diesel-electricity generator. (29) Port propeller shaft tunnel. (30) Cold store. (31) Tourist class entrance hall. (32) Tourist lounge. (33) Tourist cabins. (34) Tourist dining room. (35) Tourist cabins. (36) Port and starboard propellers. (37) Stern anchor capstan. (38) Docking bridge.

DETAILS OF THE ROYAL SUITE

- A.A. Entrances on "A" deck.
 B. Bathroom and toilet.
 C. Duke of Edinburgh's stateroom.
 D.D. Communicating doors.
 E. Private dining room and lounge.
 F. Princess Elizabeth's stateroom.
 G. Bathroom and toilet.

A BUSINESS - MAN'S AIRCRAFT

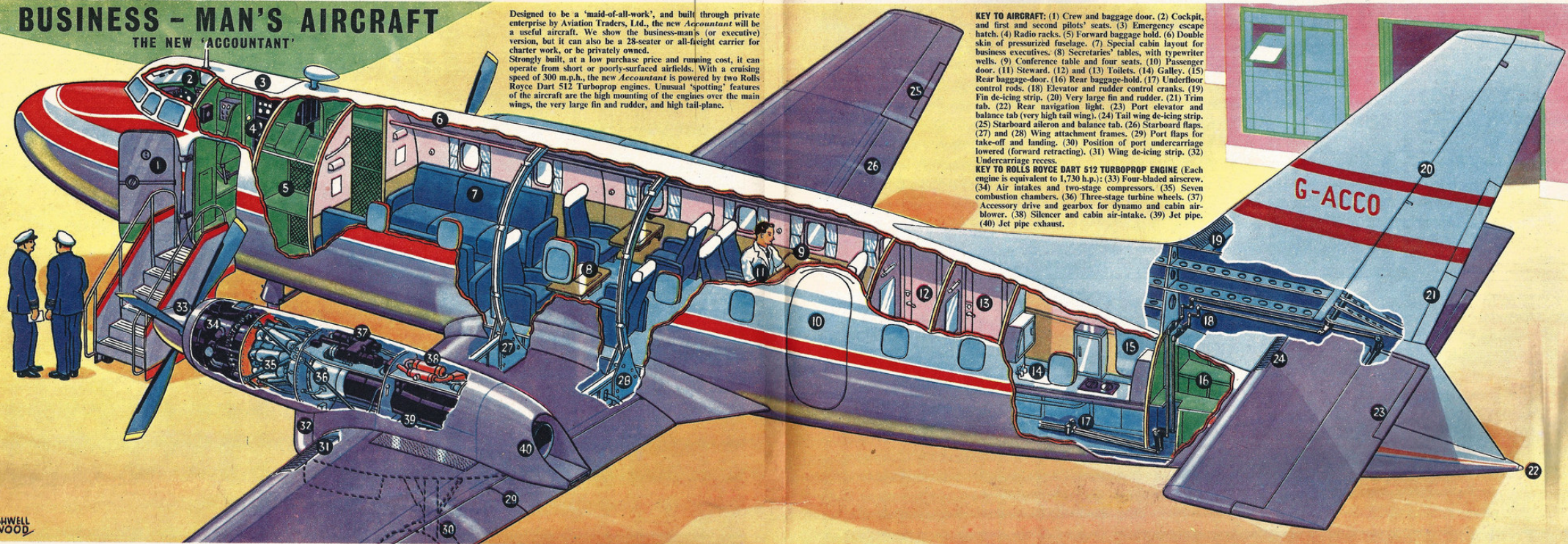
THE NEW 'ACCOUNTANT'

Designed to be a 'maid-of-all-work', and built through private enterprise by Aviation Traders, Ltd., the new *Accountant* will be a useful aircraft. We show the business-man's (or executive) version, but it can also be a 28-seater or all-freight carrier for charter work, or be privately owned.

Strongly built, at a low purchase price and running cost, it can operate from short or poorly-surfaced airfields. With a cruising speed of 300 m.p.h., the new *Accountant* is powered by two Rolls Royce Dart 512 Turboprop engines. Unusual 'spotting' features of the aircraft are the high mounting of the engines over the main wings, the very large fin and rudder, and high tail-plane.

KEY TO AIRCRAFT: (1) Crew and baggage door. (2) Cockpit, and first and second pilots' seats. (3) Emergency escape hatch. (4) Radio racks. (5) Forward baggage hold. (6) Double skin of pressurized fuselage. (7) Special cabin layout for business executives. (8) Secretaries' tables, with typewriter wells. (9) Conference table and four seats. (10) Passenger door. (11) Steward. (12) and (13) Toilets. (14) Galley. (15) Rear baggage-door. (16) Rear baggage-hold. (17) Underfloor control rods. (18) Elevator and rudder control cranks. (19) Fin de-icing strip. (20) Very large fin and rudder. (21) Trim tab. (22) Rear navigation light. (23) Port elevator and balance tab (very high tail wing). (24) Tail wing de-icing strip. (25) Starboard aileron and balance tab. (26) Starboard flaps. (27) and (28) Wing attachment frames. (29) Port flaps for take-off and landing. (30) Position of port undercarriage lowered (forward retracting). (31) Wing de-icing strip. (32) Undercarriage recess.

KEY TO ROLLS ROYCE DART 512 TURBOPROP ENGINE (Each engine is equivalent to 1,730 h.p.): (33) Four-bladed airscrew. (34) Air intakes and two-stage compressors. (35) Seven combustion chambers. (36) Three-stage turbine wheels. (37) Accessory drive and gearbox for dynamo and cabin air-blower. (38) Silencer and cabin air-intake. (39) Jet pipe. (40) Jet pipe exhaust.

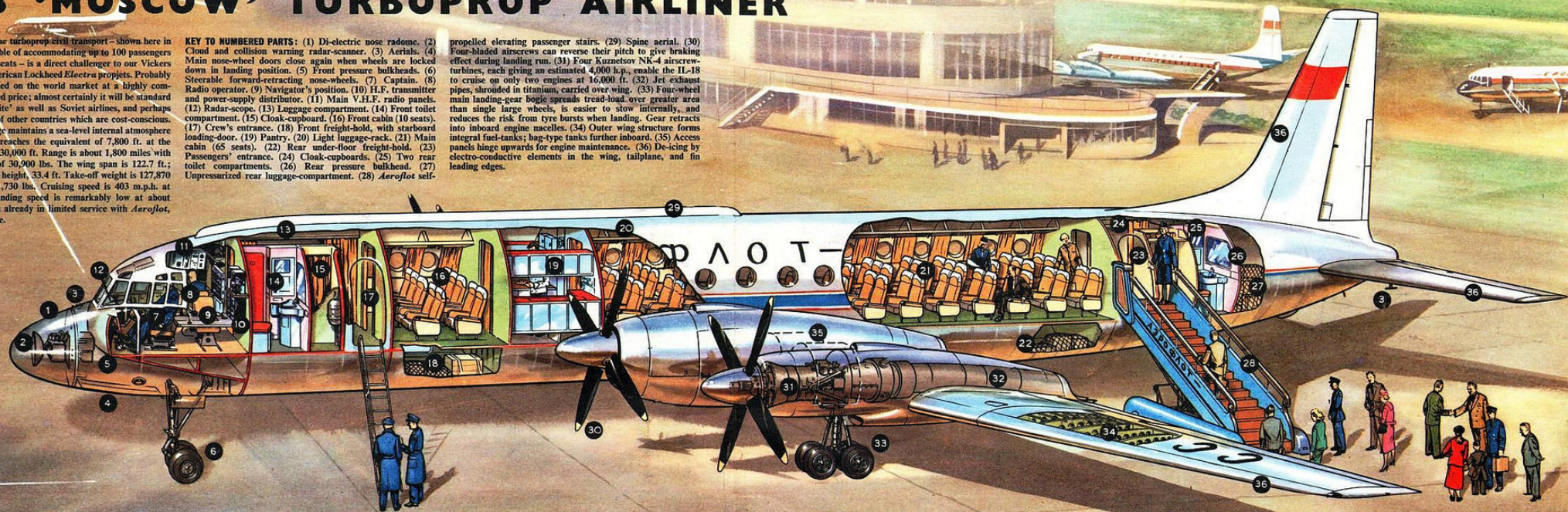


IL-18 'MOSCOW' TURBOPROP AIRLINER

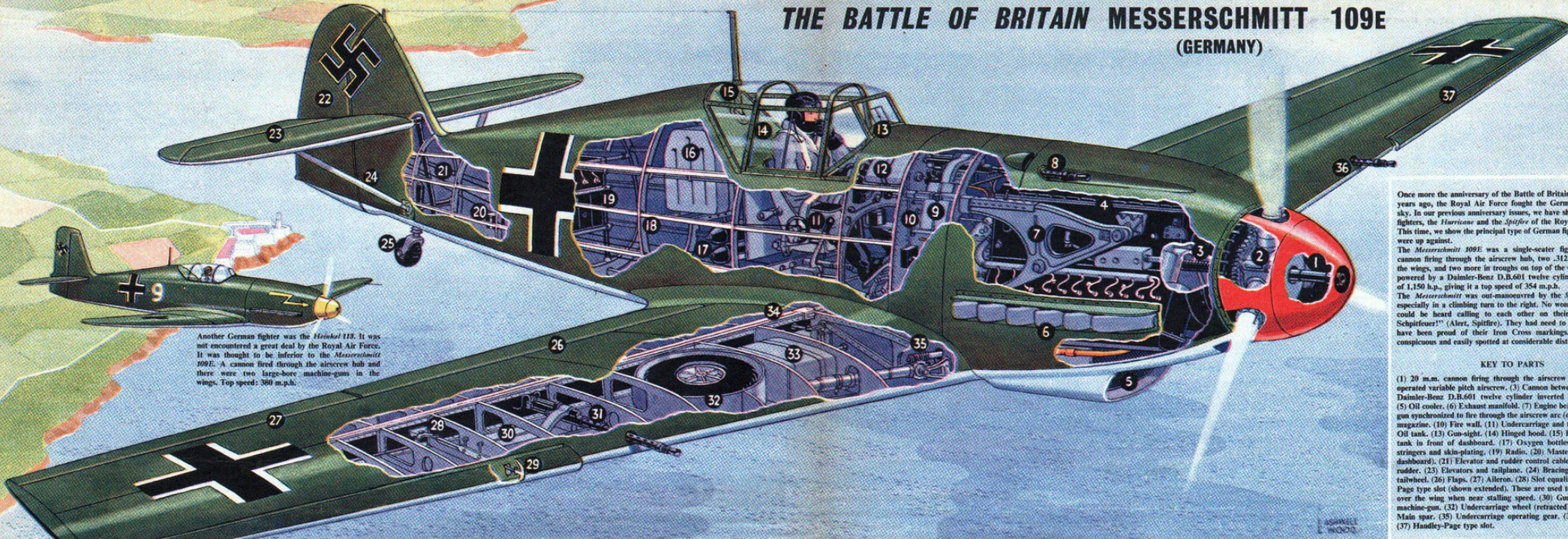
Russia's IL-18 *Moscow* turboprop civil transport—shown here in 75-seat form, but capable of accommodating up to 100 passengers in slightly less roomy seats—is a direct challenger to our Vickers *Vanguard* and the American Lockheed *Electra* propjets. Probably it will soon be launched on the world market at a highly competitive, state-subsidized price; almost certainly it will be standard equipment with 'satellite' as well as Soviet airlines, and perhaps also with the airlines of other countries which are cost-conscious. The pressurized fuselage maintains a sea-level internal atmosphere up to 17,000 ft., and reaches the equivalent of 7,800 ft. at the cruise altitude of over 30,000 ft. Range is about 1,800 miles with a maximum payload of 30,900 lbs. The wing span is 122.7 ft.; the length, 117 ft.; the height, 33.4 ft. Take-off weight is 127,870 lbs.; empty weight, 61,730 lbs. Cruising speed is 403 m.p.h. at 26,250 ft., and the landing speed is remarkably low at about 99 m.p.h. The IL-18 is already in limited service with *Aeroflot*, the Soviet State airline.

KEY TO NUMBERED PARTS: (1) Di-electric nose radome. (2) Cloud and collision warning radar-scanner. (3) Aerials. (4) Main nose-wheel doors close again when wheels are locked down in landing position. (5) Front pressure bulkheads. (6) Steerable forward-retracting nose-wheels. (7) Captain. (8) Radio operator. (9) Navigator's position. (10) H.F. transmitter and power-supply distributor. (11) Main V.H.F. radio panels. (12) Radar-scope. (13) Luggage compartment. (14) Front toilet compartment. (15) Cloak-cupboard. (16) Front cabin (10 seats). (17) Crew's entrance. (18) Front freight-hold, with starboard loading-door. (19) Pantry. (20) Light luggage-rack. (21) Main cabin (65 seats). (22) Rear under-floor freight-hold. (23) Passengers' entrance. (24) Cloak-cupboards. (25) Two rear toilet compartments. (26) Rear pressure bulkhead. (27) Unpressurized rear luggage-compartment. (28) *Aeroflot* self-

propelled elevating passenger stairs. (29) Spine aerial. (30) Four-bladed airscrews can reverse their pitch to give braking effect during landing run. (31) Four Kuznetsov NK-4 airscrew-turbines, each giving an estimated 4,000 h.p., enable the IL-18 to cruise on only two engines at 16,000 ft. (32) Jet exhaust pipes, shrouded in titanium, carried over wing. (33) Four-wheel main landing-gear bogie spreads tread-load over greater area than single large wheels, is easier to stow internally, and reduces the risk from tyre bursts when landing. Gear retracts into inboard engine nacelles. (34) Outer wing structure forms integral fuel-tanks; bag-type tanks further inboard. (35) Access panels hinge upwards for engine maintenance. (36) De-icing by electro-conductive elements in the wing, tailplane, and fin leading edges.



THE BATTLE OF BRITAIN MESSERSCHMITT 109E (GERMANY)



Another German fighter was the Heinkel 113. It was not encountered a great deal by the Royal Air Force. It was thought to be inferior to the Messerschmitt 109E. A cannon fired through the airscrew hub and there were two large-bore machine-guns in the wings. Top speed: 380 m.p.h.

Once more the anniversary of the Battle of Britain comes round. Fifteen years ago, the Royal Air Force fought the German fighters out of the sky. In our previous anniversary issues, we have shown the world-famous fighters, the Hurricane and the Spitfire of the Royal Air Force. This time, we show the principal type of German fighter which our airmen were up against.

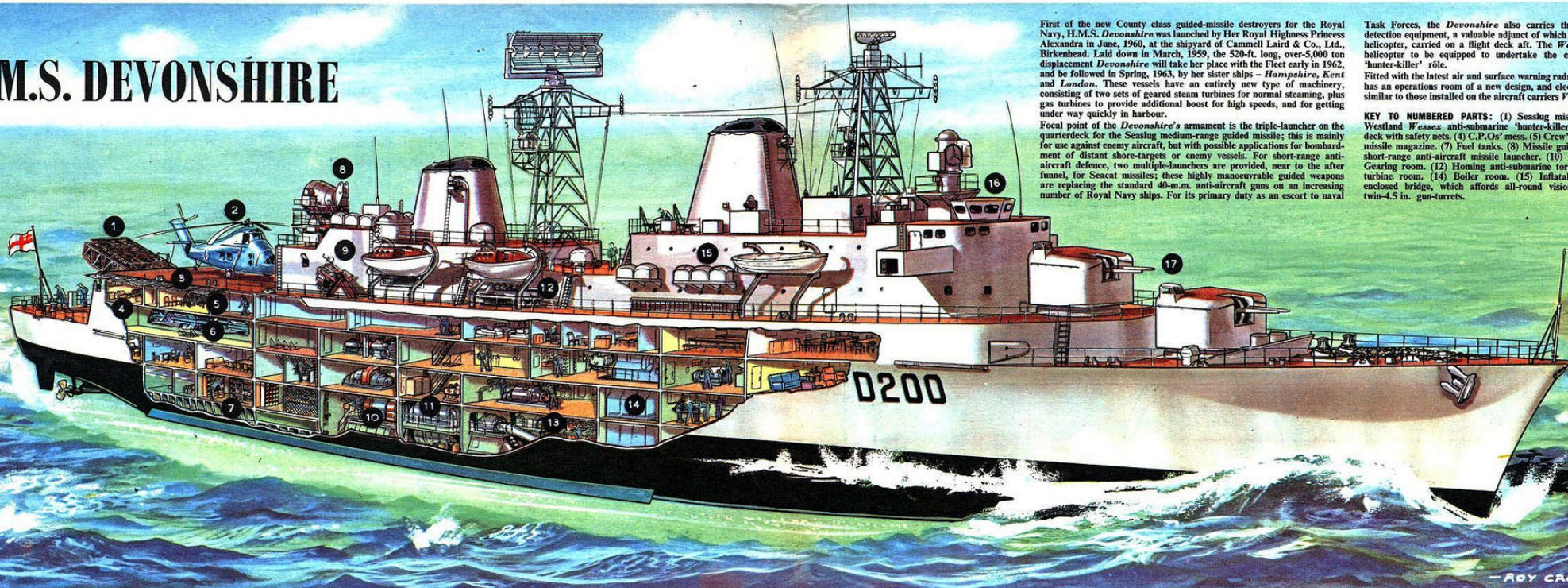
The Messerschmitt 109E was a single-seater fighter with a 20 m.m. cannon firing through the airscrew hub, two .312 inch machine-guns in the wings, and two more in troughs on top of the engine cowlings. It was powered by a Daimler-Benz D.B.601 twelve cylinder inverted V engine of 1,150 h.p., giving it a top speed of 354 m.p.h.

The Messerschmitt was out-manoeuvred by the Spitfire and Hurricane, especially in a climbing turn to the right. No wonder the German pilots could be heard calling to each other on their wireless, "Achtung, Schpitfire!" (Alert, Spitfire). They had need to keep alert. They may have been proud of their Iron Cross markings, but they were very conspicuous and easily spotted at considerable distances.

KEY TO PARTS

(1) 20 m.m. cannon firing through the airscrew hub. (2) Electrically-operated variable pitch airscrew. (3) Cannon between cylinder banks. (4) Daimler-Benz D.B.601 twelve cylinder inverted V engine; 1,150 h.p. (5) Oil cooler. (6) Exhaust manifold. (7) Engine bearer. (8) .312 machine-gun synchronized to fire through the airscrew arc (one each side). (9) Gun magazine. (10) Fire wall. (11) Undercarriage and tailplane controls. (12) Oil tank. (13) Gun-sight. (14) Hinged hood. (15) Radio aerial. (16) Fuel tank in front of dashboard. (17) Oxygen bottles. (18) Metal frames, stringers and skin-plating. (19) Radio. (20) Master compass (repeats on dashboard). (21) Elevator and rudder control cables. (22) Fabric-covered rudder. (23) Elevators and tailplane. (24) Bracing strut. (25) Castoring tailwheel. (26) Flaps. (27) Aileron. (28) Slot equalizer rod. (29) Handley-Page type slot (shown extended). These are used to increase the air-flow over the wing when near stalling speed. (30) Gun magazine. (31) .312 machine-gun. (32) Undercarriage wheel (retracted). (33) Fuel tank. (34) Main spar. (35) Undercarriage operating gear. (36) .312 machine-gun. (37) Handley-Page type slot.

H.M.S. DEVONSHIRE



First of the new County class guided-missile destroyers for the Royal Navy, H.M.S. *Devonshire* was launched by Her Royal Highness Princess Alexandra in June, 1960, at the shipyard of Cammell Laird & Co., Ltd., Birkenhead. Laid down in March, 1959, the 520-ft. long, over-5,000 ton displacement *Devonshire* will take her place with the Fleet early in 1962, and be followed in Spring, 1963, by her sister ships - *Hampshire*, *Kent* and *London*. These vessels have an entirely new type of machinery, consisting of two sets of geared steam turbines for normal steaming, plus gas turbines to provide additional boost for high speeds, and for getting under way quickly in harbour.

Focal point of the *Devonshire's* armament is the triple-launcher on the quarterdeck for the Seaslug medium-range guided missile; this is mainly for use against enemy aircraft, but with possible applications for bombardment of distant shore-targets or enemy vessels. For short-range anti-aircraft defence, two multiple-launchers are provided, near to the after funnel, for Seacat missiles; these highly manoeuvrable guided weapons are replacing the standard 40-m.m. anti-aircraft guns on an increasing number of Royal Navy ships. For its primary duty as an escort to naval

Task Forces, the *Devonshire* also carries the latest anti-submarine detection equipment, a valuable adjunct of which is the Westland *Wessex* helicopter, carried on a flight deck aft. The *Wessex* is the first British helicopter to be equipped to undertake the complete anti-submarine 'hunter-killer' rôle.

Fitted with the latest air and surface warning radar, H.M.S. *Devonshire* has an operations room of a new design, and electronic plotting facilities similar to those installed on the aircraft carriers *Victorious* and *Hermes*.

KEY TO NUMBERED PARTS: (1) Seaslug missile triple-launcher. (2) Westland *Wessex* anti-submarine 'hunter-killer' helicopter. (3) Flight deck with safety nets. (4) C.P.O.'s mess. (5) Crew's dining hall. (6) Seaslug missile magazine. (7) Fuel tanks. (8) Missile guidance radar. (9) Seacat short-range anti-aircraft missile launcher. (10) Gas turbine room. (11) Gearing room. (12) Homing anti-submarine torpedo tubes. (13) Steam turbine room. (14) Boiler room. (15) Inflatable life-rafts. (16) The enclosed bridge, which affords all-round vision. (17) Radar-directed twin-4.5 in. gun-turrets.

NEW BRITISH LANDING CRAFT FOR NIGERIA

An interesting new landing craft, or transport, recently been built by Thames Launch Works Ltd., Twickenham, Middlesex, for the Government of Nigeria. The vessel has been named *Rivers Monarch*, and is used to carry tractors or cargo up the delta of the Niger River, West Africa, in connection with the clearing of swamp areas and the cultivation of a huge rice-growing area. The vessel has a loading deck, with a ramp door at the stern. This door is operated by two winches, port and starboard, of the forward end. Two Gardner marine Diesel engines develop 112 h.p., and drive the two propellers; there are twin rudders. The dead weight capacity is 35 tons, and

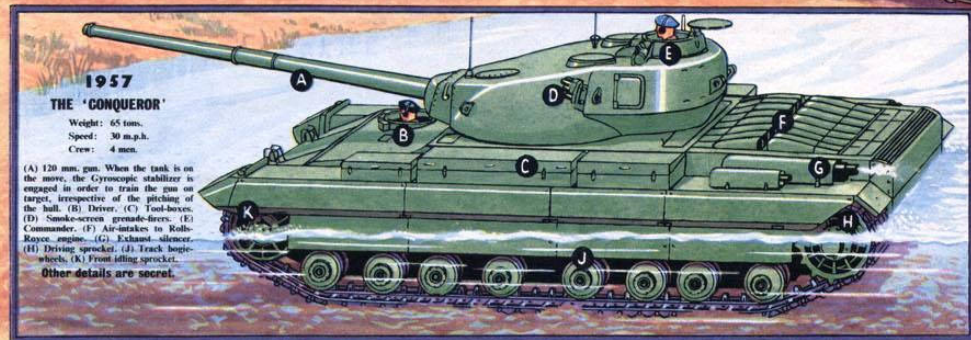
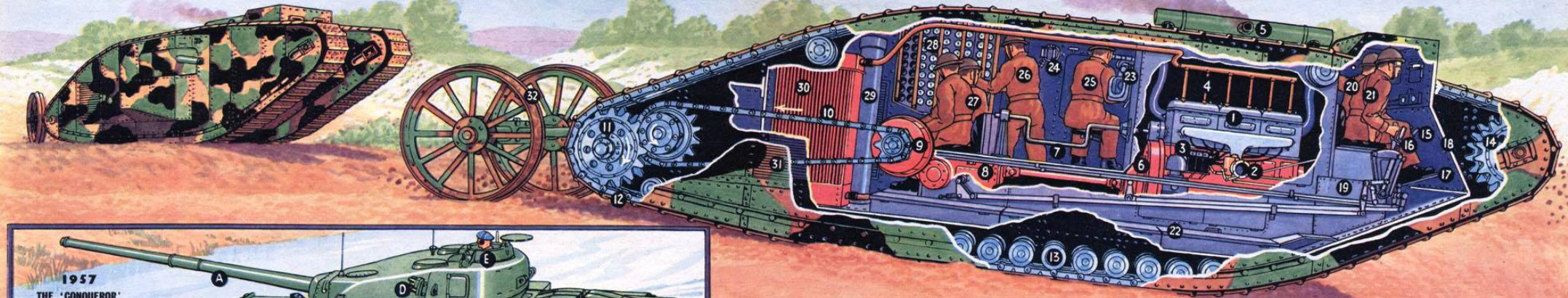
3 ft. 6 in. draught for river work. Speed, 8½ knots; length, 69 ft. 9 ins.; breadth, 18 ft. Accommodation comprises a Master's cabin, Engineer's cabin, and a double-birth crew's cabin; also a toilet and galley.

KEY TO NUMBERED PARTS: (1) Ramp door. (2) Apertures, for steering visibility. (3) Position of ramp door when lowered. (4) Door chain. (5) Mooring winch. (6) Door chain holding winch (port and starboard). (7) Bilge pump. (8) Eye plate, for hauling on and off beaches. (9) Fresh-water ballast tank in double bottom - 1,000 gallons. (10) Sea-water ballast space. (11) Loading deck. (12) Water-freeing ports, should

the sea come over the sides. (13) Auxiliary Diesel engine and 24-volt generator. (14) Port Gardner Diesel engine - 112 h.p. (15) Diesel oil-tanks (either side); 2 tons each. (16) Engine controls from bridge. (17) Exhaust pipe to funnel. (18) Starboard Gardner Diesel engine - 112 h.p. (19) Exhaust pipe to funnel. (20) Reduction and reverse gearbox. (21) Starboard propeller and rudder. (22) Stores. (23) Fresh-water tank. (24) Steering cable. (25) Galley. (26) Toilet. (27) Master's cabin. (28) Engine-room vent. (29) Canopy deck, for the convenience of passengers. (30) Navigating bridge. (31) Searchlight. (32) Navigation lights. (33) Streamlined funnel.



THE WORLD'S FIRST TANK – AND THE LATEST



1957

THE 'CONQUEROR'

Weight: 65 tons.
Speed: 30 m.p.h.
Crew: 4 men.

(A) 120 mm. gun. When the tank is in the move, the Gyroscopic stabilizer is engaged in order to train the gun on target, irrespective of the pitching of the hull. (B) Driver. (C) Tool-boxes. (D) Smoke-screen grenade-firers. (E) Commander. (F) Air-intakes to Rolls-Royce engine. (G) Exhaust-silencer. (H) Driving sprocket. (J) Track bogie-wheels. (K) Front idling sprocket.

Other details are secret.

Forty-one years ago this year, in 1916, during World War I, the World's first tanks to go into action loomed up in the early morning mist on the Somme front. These steel monsters trundled along at a steady 4 m.p.h. – a secret weapon which was to revolutionize battle-tactics. It is interesting to note that, for the sake of secrecy while being built, they were called water-carriers; and finally merely a 'tank' – hence the name to this day. The first production machines were known as Mark I, and 150 were built: 75 were called 'males' (with two six-pounder guns and four machine-guns), and 75 'females' (with six machine-guns). They had a crew of eight, were 27 feet long, and weighed some 28 tons.

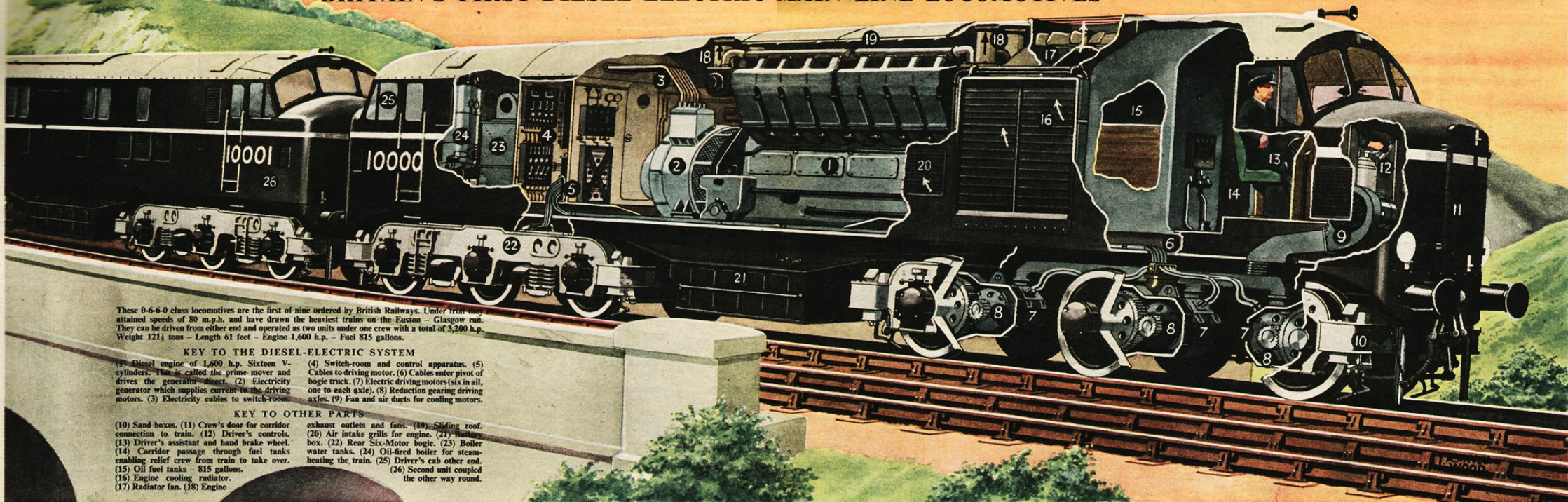
A Daimler, 6-cylinder, sleeve-valve petrol-engine of 105 h.p. provided the motive power. A pair of heavy wheels were mounted at the rear to help steering, but were removed in later Marks as they proved too cumbersome. As for the courage of the crews – well, the fumes, vibration, noise and shock can better be imagined than described! Inset on the left is Britain's super-tank, the *Conqueror*.

KEY TO HOW IT WORKS: (1) Daimler, 6-cylinder, 105 h.p., sleeve-valve petrol-engine. (2) Carburettor air-intake. (3) Magneto. (4) Water-cooling pipes. (5) Exhaust silencer. (6) Flywheel and engine-clutch. (7) Starting handle. (8) First gearbox; four forward speeds and two reverse. (9) Secondary epicyclic gearbox and final drive (both sides). (10) Driving chain (both sides). (11) Driving sprocket. (12) Tracks with chain-links. (13) Track rollers. (14) Front idling sprocket. (15) Track control-levers. Steering was done by locking one of the track gearboxes and allowing the other to take up the drive. (16) Track gearbox control-lever, and forward and reverse gearbox lever. (17) Brake and engine clutch-pedals. (18) 12 mm.-thick front armour-

plating. (19) Petrol tank – 46 gallons. This proved highly dangerous, and was later removed to the rear.

KEY TO OTHER DETAILS: (20) Tank Commander. He gave hand-signal instructions to the two gear-men. (21) Driver. (22) Gangway over tool-boxes. (23) Port, 6-pounder Hotchkiss gun. (24) One of four Vickers machine-guns. (25) Port gunner. (26) Port loader; two others on the near starboard side (not shown). (27) Two gear-men. These were instructed which gears to engage. (28) 6-pounder ammunition, port and starboard. (29) Radiator water-tank. (30) Engine water-cooling radiator, with fan behind. (31) Radiator air grille. (32) Trailing wheels to assist steering.

BRITAIN'S FIRST DIESEL-ELECTRIC MAIN LINE LOCOMOTIVES



These 0-6-6-0 class locomotives are the first of nine ordered by British Railways. Under trial they attained speeds of 80 m.p.h. and have drawn the heaviest trains on the Euston - Glasgow run. They can be driven from either end and operated as two units under one crew with a total of 3,200 h.p. Weight 121½ tons - Length 61 feet - Engine 1,600 h.p. - Fuel 815 gallons.

KEY TO THE DIESEL-ELECTRIC SYSTEM

(1) Diesel engine of 1,600 h.p. Sixteen V-cylinders. This is called the prime mover and drives the generator direct. (2) Electricity generator which supplies current to the driving motors. (3) Electricity cables to switch-room. (4) Switch-room and control apparatus. (5) Cables to driving motor. (6) Cables enter pivot of bogie truck. (7) Electric driving motors (six in all, one to each axle). (8) Reduction gearing driving axles. (9) Fan and air ducts for cooling motors.

KEY TO OTHER PARTS

(10) Sand boxes. (11) Crew's door for corridor connection to train. (12) Driver's controls. (13) Driver's assistant and hand brake wheel. (14) Corridor passage through fuel tanks enabling relief crew from train to take over. (15) Oil fuel tanks - 815 gallons. (16) Engine cooling radiator. (17) Radiator fan. (18) Engine exhaust outlets and fans. (19) Sliding roof. (20) Air intake grills for engine. (21) Battery box. (22) Rear Six-Motor bogie. (23) Boiler water tanks. (24) Oil-fired boiler for steam heating the train. (25) Driver's cab other end. (26) Second unit coupled the other way round.

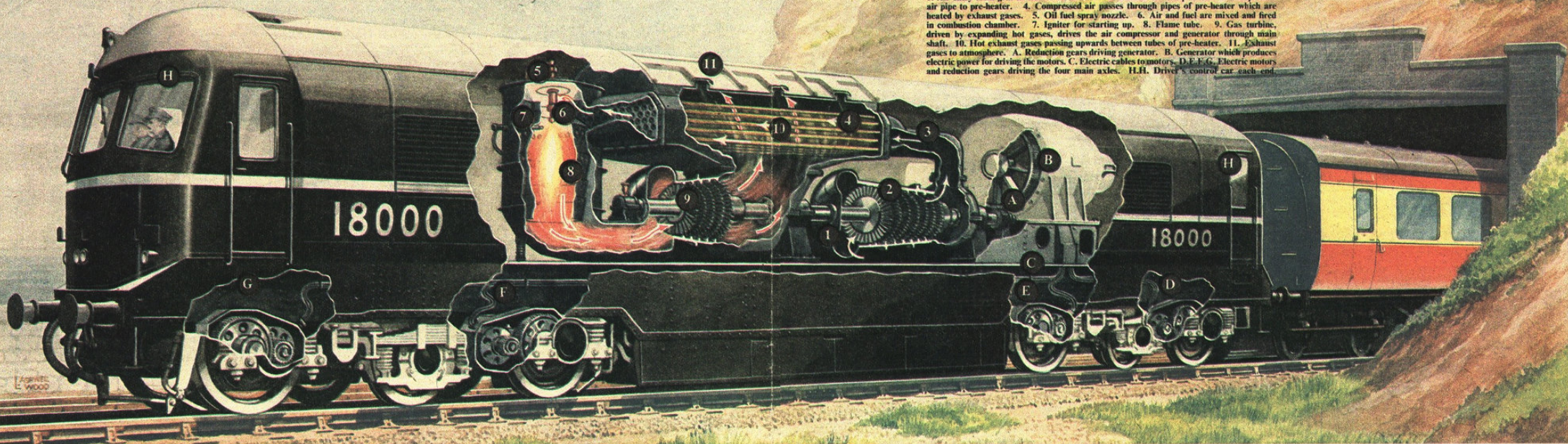
THE NEW GAS TURBINE-ELECTRIC LOCOMOTIVE

A new-comer to British Railways that will run on the Western Region Section

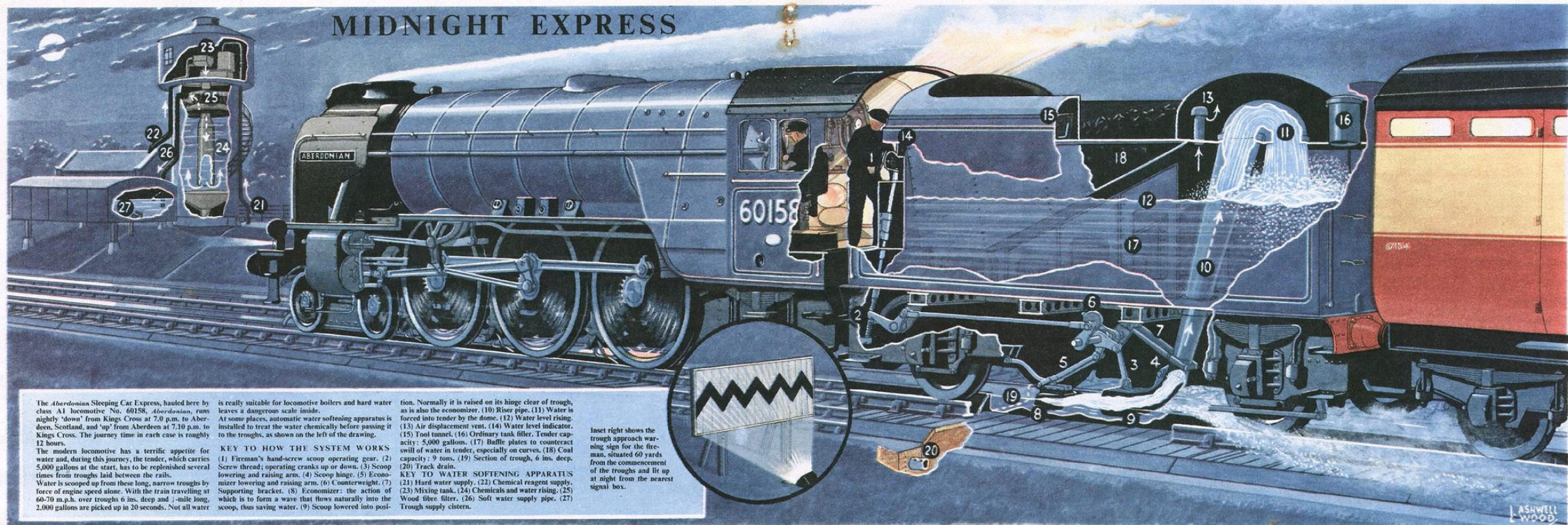
Length 70 ft. Weight 117 tons.

KEY TO CYCLE OF OPERATIONS

1. Air entry from grill at side of locomotive. 2. Turbine air compressor. 3. Compressed air pipe to pre-heater. 4. Compressed air passes through pipes of pre-heater which are heated by exhaust gases. 5. Oil fuel spray nozzle. 6. Air and fuel are mixed and fired in combustion chamber. 7. Igniter for starting up. 8. Flame tube. 9. Gas turbine, driven by expanding hot gases, drives the air compressor and generator through main shaft. 10. Hot exhaust gases passing upwards between tubes of pre-heater. 11. Exhaust gases to atmosphere. A. Reduction gears driving generator. B. Generator which produces electric power for driving the motors. C. Electric cables to motors. D, E, F, G. Electric motors and reduction gears driving the four main axes. H, H. Drivers' control car each end.



MIDNIGHT EXPRESS



The Aberdonian Sleeping Car Express, hauled here by class A1 locomotive No. 60158, Aberdonian, runs nightly 'down' from Kings Cross at 7.0 p.m. to Aberdeen, Scotland, and 'up' from Aberdeen at 7.10 p.m. to Kings Cross. The journey time in each case is roughly 12 hours.

The modern locomotive has a terrific appetite for water and, during this journey, the tender, which carries 5,000 gallons at the start, has to be replenished several times from troughs laid between the rails. Water is scooped up from these long, narrow troughs by force of engine speed alone. With the train travelling at 60-70 m.p.h. over troughs 6 ins. deep and 1-mile long, 2,000 gallons are picked up in 20 seconds. Not all water

is really suitable for locomotive boilers and hard water leaves a dangerous scale inside. At some places, automatic water softening apparatus is installed to treat the water chemically before passing it to the troughs, as shown on the left of the drawing.

KEY TO HOW THE SYSTEM WORKS

(1) Fireman's hand-screw scoop operating gear. (2) Screw thread; operating cranks up or down. (3) Scoop lowering and raising arm. (4) Scoop hinge. (5) Economizer lowering and raising arm. (6) Counterweight. (7) Supporting bracket. (8) Economizer: the action of which is to form a wave that flows naturally into the scoop, thus saving water. (9) Scoop lowered into position.

Normally it is raised on its hinge clear of trough, as is also the economizer. (10) Riser pipe. (11) Water is forced into tender by the dome. (12) Water level rising. (13) Air displacement vent. (14) Water level indicator. (15) Tool tunnel. (16) Ordinary tank filler. Tender capacity: 5,000 gallons. (17) Baffle plates to counteract swirl of water in tender, especially on curves. (18) Coal capacity: 9 tons. (19) Section of trough, 6 ins. deep. (20) Track drain.

KEY TO WATER SOFTENING APPARATUS (21) Hard water supply. (22) Chemical reagent supply. (23) Mixing tank. (24) Chemicals and water rising. (25) Wood fibre filter. (26) Soft water supply pipe. (27) Trough supply cistern.

Inset right shows the trough approach warning sign for the fireman, situated 60 yards from the commencement of the troughs and lit up at night from the nearest signal box.

BRITISH RAILWAYS CLASS "4" (TANK)

This is the fifth in our series of British Railways Standard steam locomotives. The use of tank engines, carrying their supplies of coal and water on their own main frames, instead of in a separate tender, is confined mainly to Great Britain. These numerous two-cylinder 2-6-4 tanks are capable of fast and heavy work over fairly long distances. The insets on the right are of the remaining seven types of Standard locomotives and complete the series of twelve. Each one has a different duty to perform. If you keep these for reference, with the other five, you will have a record of steam locomotives to be built until 1957; after that date, all new types will be Diesel, Diesel Electric and Electric, under the British Railways' future modernization scheme.

KEY TO HOW IT WORKS: (1) Coal bunker (3½ tons). (2) Rear water-tank. (3) Main side-tank, connected with rear-tank; total capacity 2,000 gallons. (4) Boiler feed water-valves (each side). (5) Water level in boiler and over firebox. (6) Steam rises to this dome and is admitted by the driver's regulator valve to main steam-pipe. (7) Main steam-pipe to superheater. (8) Superheater. (9) Steam passes back into boiler via pipes inside these flue tubes and returns superheated. (10) Fire tubes from firebox which heat the surrounding water. (11) Superheated steam-pipe to cylinder (one each side). (12) Piston valves which control steam entry and exhaust. (13) Piston, on backward stroke. The exhaust is fully open, but the inlet valve has just closed.

the expanding steam driving the piston back. (14) Exhaust blast pipe. (15) Path of air and gases from firebox. (16) Spark arrester plate. (17) Radius rod, working piston valves. (18) Reversing link of Walschaert valve gear, shown here in forward gear. (19) Connecting rod to driving wheel. (20) Return crank and rod, operating reversing link. (21) Coupling rod to coupled wheels. (22) Sand-pipe. (23) Sand-box. (24) Mechanical lubricator. (25) Tank filler. (26) Inner firebox and brick arch. (27) Outer firebox and stays. (28) Safety valves. (29) Auxiliary steam-supply pipes for operating water injector, steam brake, etc. (30) Rear look-out window; these locomotives work equally well backwards as forwards.



Class "6" Mixed Traffic.
4-6-2. Weight in working order: 86 tons 19 cwt. Tender: 47 tons 4 cwt.



Class "4" Mixed Traffic.
4-6-0. Weight in working order: 69 tons. Tender: 43 tons 3 cwt.



Class "4" Mixed Traffic.
2-6-0. Weight in working order: 59 tons 2 cwt. Tender: 42 tons 3 cwt.



Class "3" Mixed Traffic.
2-6-0. Weight in working order: 57 tons 10 cwt. Tender: 42 tons 3 cwt.



Class "2" Mixed Traffic.
2-6-0. Weight in working order: 49 tons 5 cwt. Tender: 36 tons 17 cwt.



Class "2" (Tank).
2-6-2. Weight in working order: 63 tons 5 cwt.



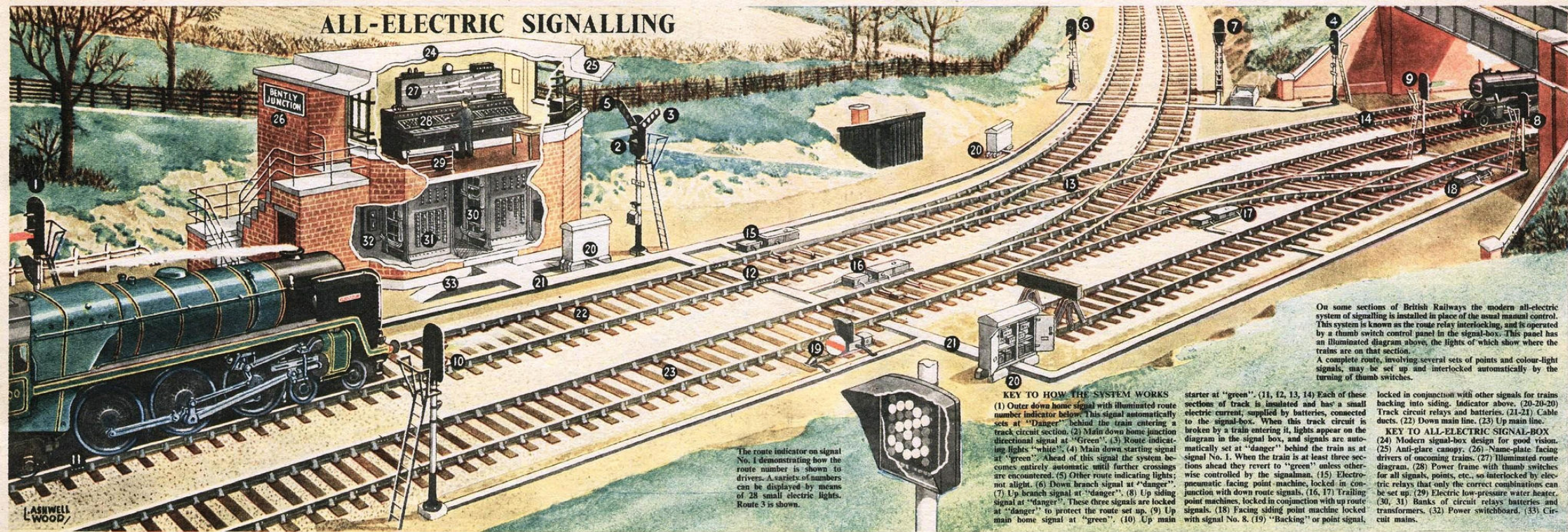
Class "3" (Tank).
2-6-2. Weight in working order: 73 tons 10 cwt.



British Railways Standard Class "4" (Tank).
2-6-4. Weight in working order: 88 tons 10 cwt.

LASHWELL
WOOD

ALL-ELECTRIC SIGNALLING



On some sections of British Railways the modern all-electric system of signalling is installed in place of the usual manual control. This system is known as the route relay interlocking, and is operated by a thumb switch control panel in the signal-box. This panel has an illuminated diagram above, the lights of which show where the trains are on that section. A complete route, involving several sets of points and colour-light signals, may be set up and interlocked automatically by the turning of thumb switches.

KEY TO HOW THE SYSTEM WORKS

(1) Outer down home signal with illuminated route number indicator below. This signal automatically sets at "Danger" behind the train entering a track circuit section. (2) Main down home junction directional signal at "Green". (3) Route indicating lights "white". (4) Main down starting signal at "green". Ahead of this signal the system becomes entirely automatic until further crossings are encountered. (5) Other route indicating lights; not alight. (6) Down branch signal at "danger". (7) Up branch signal at "danger". (8) Up siding signal at "danger". These three signals are locked at "danger" to protect the route set up. (9) Up main home signal at "green". (10) Up main

starter at "green". (11, 12, 13, 14) Each of these sections of track is insulated and has a small electric current, supplied by batteries, connected to the signal-box. When this track circuit is broken by a train entering it, lights appear on the diagram in the signal box, and signals are automatically set at "danger" behind the train as at signal No. 1. When the train is at least three sections ahead they revert to "green" unless otherwise controlled by the signalman. (15) Electro-pneumatic facing point machine, locked in conjunction with down route signals. (16, 17) Trailing point machines, locked in conjunction with up route signals. (18) Facing siding point machine locked with signal No. 8. (19) "Backing" or point signal,

locked in conjunction with other signals for trains backing into siding. Indicator above. (20-20-20) Track circuit relays and batteries. (21-21) Cable ducts. (22) Down main line. (23) Up main line.

KEY TO ALL-ELECTRIC SIGNAL-BOX

(24) Modern signal-box design for good vision. (25) Anti-glare canopy. (26) Name-plate facing drivers of oncoming trains. (27) Illuminated route diagram. (28) Power frame with thumb switches for all signals, points, etc., so interlocked by electric relays that only the correct combinations can be set up. (29) Electric low-pressure water heater. (30, 31) Banks of circuit relays batteries and transformers. (32) Power switchboard. (33) Circuit mains.

The route indicator on signal No. 1 demonstrating how the route number is shown to drivers. A variety of numbers can be displayed by means of 28 small electric lights. Route 3 is shown.

A MODERN BRITISH COAL MINE

Millions of tons of coal are mined in Great Britain every year. The actual mining of the coal in an up-to-date coal mine is shown in this drawing.

The system used is known as the double-unit longwall; that is, the coal is attacked along its face, one unit cutting and one unit filling. Very important indeed is the ventilation system, whereby fresh air is circulated to every corner of the mine, and foul air exhausted to the atmosphere above. The large white arrows indicate the path of the air.

If this part of the page is carefully attached underneath last week's issue of EAGLE, you have the complete story of coal, above and below ground.

KEY TO MOVEMENT OF COAL

(1) Coal seam, 5 ft. thick. (2) Face of one unit of longwall system. (3) Position of future cuts. (4) Coal cutting machine, undercutting seam 2 ft. 6 ins. deep. (5) Compressed air supply pipe for coal cutter. (6) Face conveyor idle while coal is being cut. (7) Props and "cogs" for supporting roof while coal is cut. (8)-(9) Stone packs, built up to support the stone roof at each side of roads. (10) Waste or "goaf". The roof is allowed to cave in, between packs, as the work progresses. (11) Coal cutter idle while filling is going on. (12) The undercut face of the other longwall unit is collapsed ready for filling. (13) Fillers placing coal on the face conveyor. When the coal has been cleared the stone packs and roof timbers are advanced, ready for the next cut, the fillers going over to the other unit to clear the face now being cut. This goes on night and day advancing into the seam at about 5 yards per week. There would be several other such workings or "drifts" as this in the same coal mine. (14) Face conveyor delivering coal to larger gate conveyor. (15) Gate conveyor taking coal from face to delivery point. (16) Stone and shale roof. (17) Gate conveyor delivering coal to waiting tubs or "trams". (18)-(19) Full tubs gravitating to cages. (19)-(20) Onsetter in charge of cages and in touch with banksmen at top of shaft. (20)-(21) Full tubs going into cages push out empties brought down. (21) Empties returning to be refilled. These are hauled back up by cables. (22) "Paddy mail" bringing miners from workings along the main haulage road. Called "outbye", the other paddy mail, going up, is called "inbye".

KEY TO VENTILATING SYSTEM

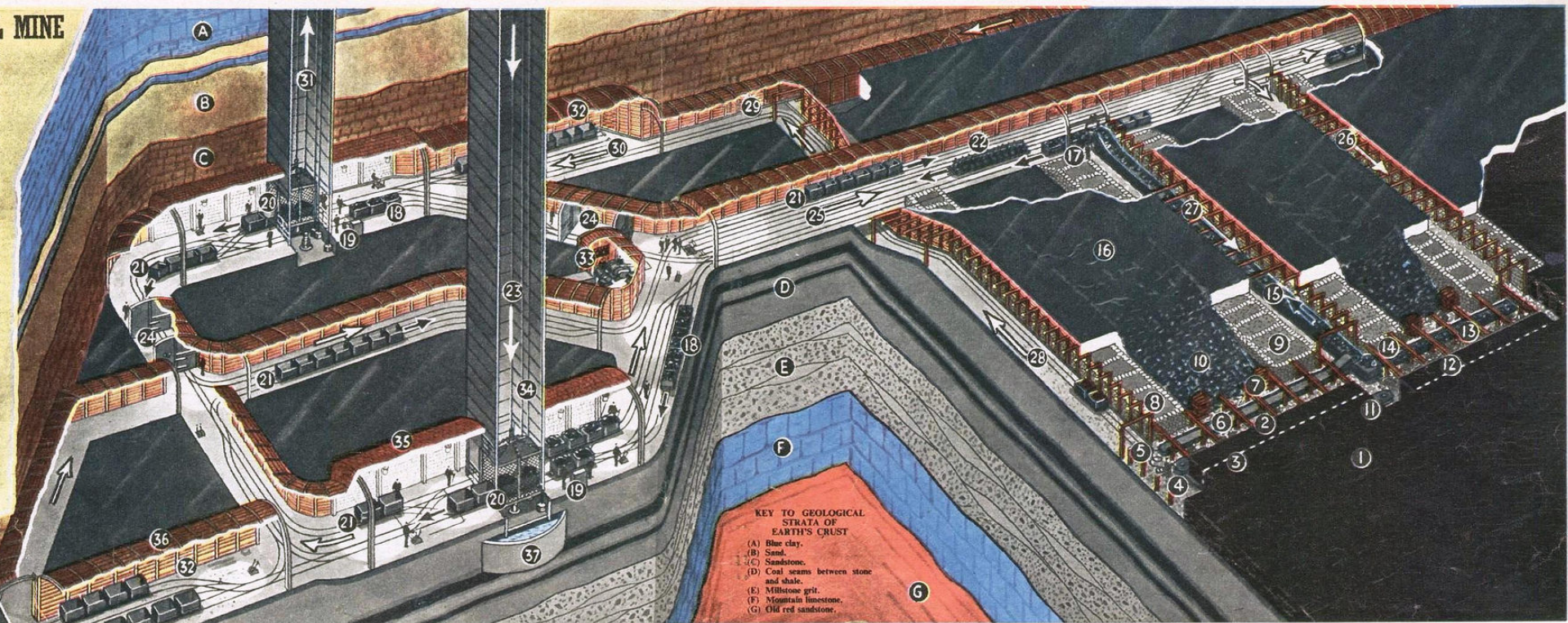
(23) Downcast shaft and air supply. (24)-(25) Air locks, operating between the downcast air and the upcast. Tubs are controlled through one door, which is then closed and the other opened. (25) Downcast air proceeds up the main haulage road. (26) Air supply to the face by the tail road. (27) Air supply to the face by the gate road. (28) Return air tail road, also used for bringing up supplies etc. to face. (29) Main upcast return air road. (30) Upcast air to shaft. (31) Upcast shaft. Air drawn up by fans above.

KEY TO OTHER NUMBERS

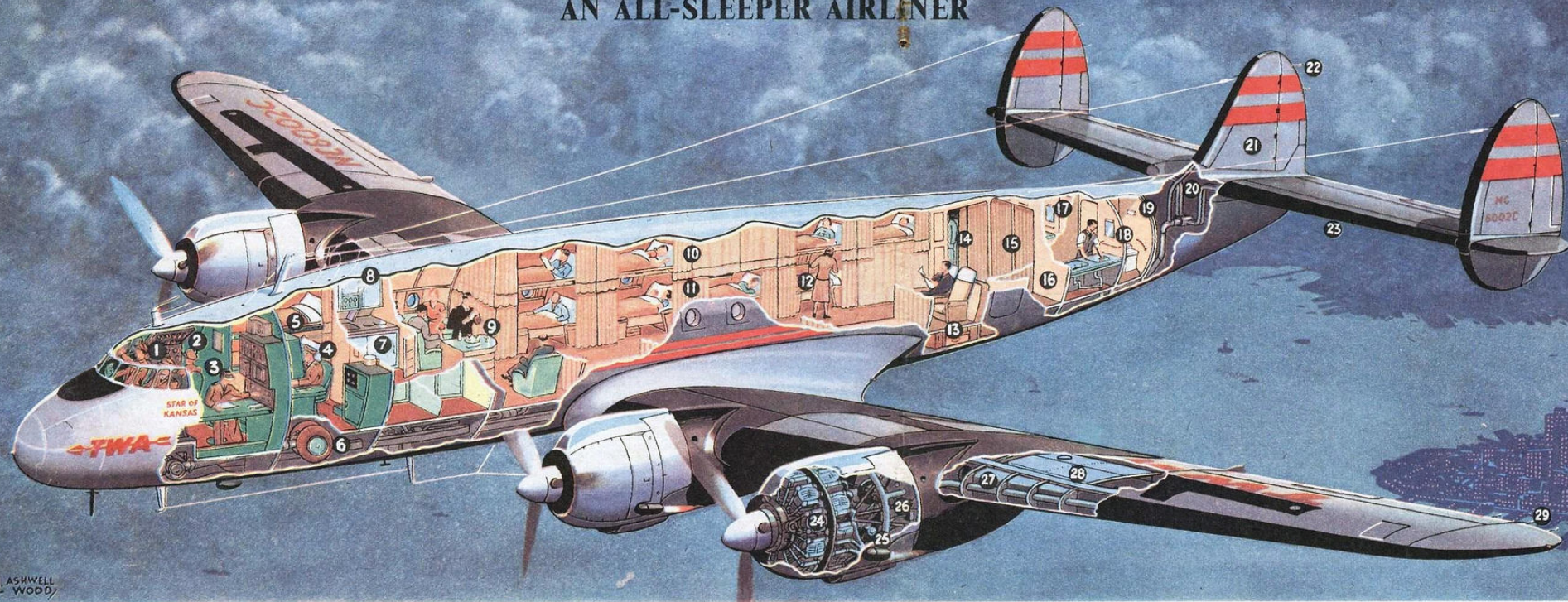
(32) Tub sidings. (33) Haulage machinery. (34) Cage guides. (35) Brick built chambers at shaft bottom. (36) Permanent roads built up of steel arches with wooden battens. (37) Water sump. This is the lowest part of the mine, to which water drains, then being pumped to the surface.

KEY TO GEOLOGICAL STRATA OF EARTH'S CRUST

- (A) Blue clay.
- (B) Sand.
- (C) Sandstone.
- (D) Coal seams between stone and shale.
- (E) Millstone grit.
- (F) Mountain limestone.
- (G) Old red sandstone.



AN ALL-SLEEPER AIRLINER



These luxury Transatlantic All-Sleeper flights, called *The Ambassadors*, are run by the Trans-World Airlines. One of them is shown here leaving New York and heading east on its non-stop journey to London or Paris. These flights are operated by Lockheed Constellation aircraft which have four 18 cylinder Wright Cyclone engines, giving a total power output of 10,000 h.p. Each flight is limited to 18 sleeping berths, 9 upper and 9 lower. One goes to bed in comfort when leaving New York and wakes in the morning in London.

KEY TO PARTS

(1) Captain and First Officer. (2) Flight Engineer. (3) Radio and Radar operator. (4) Navigating Officer. (5) Crew's rest room. (6) Retractable nose wheels. (7) Galley where hot meals are prepared. (8) Double skin of pressurized cabins. (9) Specially designed cocktail bar. (10) Upper berths on starboard side. (11) Lower berths on starboard side. (12) Stewardess. (13) Baggage space. (14) Wardrobe. (15) Entrance to Ladies' and Gentlemen's compartments. (16) Wardrobe. (17) Ladies' wash room and toilet. (18) Gentlemen's wash room. (19) Gentlemen's toilet. (20) De-icing pipes for tail plane and fins. (21) Triple fins and rudders, a feature of this aircraft. (22) Static electricity conductors. (23) De-icing leading edge of tail plane. (24) Outer port, 2,500 h.p. 18 cylinder Wright Cyclone radial air-cooled engine. (25) Engine exhaust (each side). (26) Fire wall. (27) Wing leading edge de-icing pipe supplied with warm air from engine exhausts. (28) Outer port fuel tank in wing. (29) Static electricity conductors.

12 EAGLE Club members can see over this TWA Ambassador at London Airport. See page 11 for details.

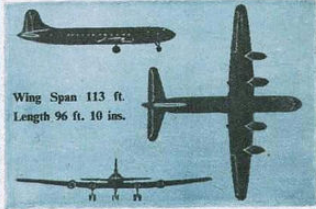
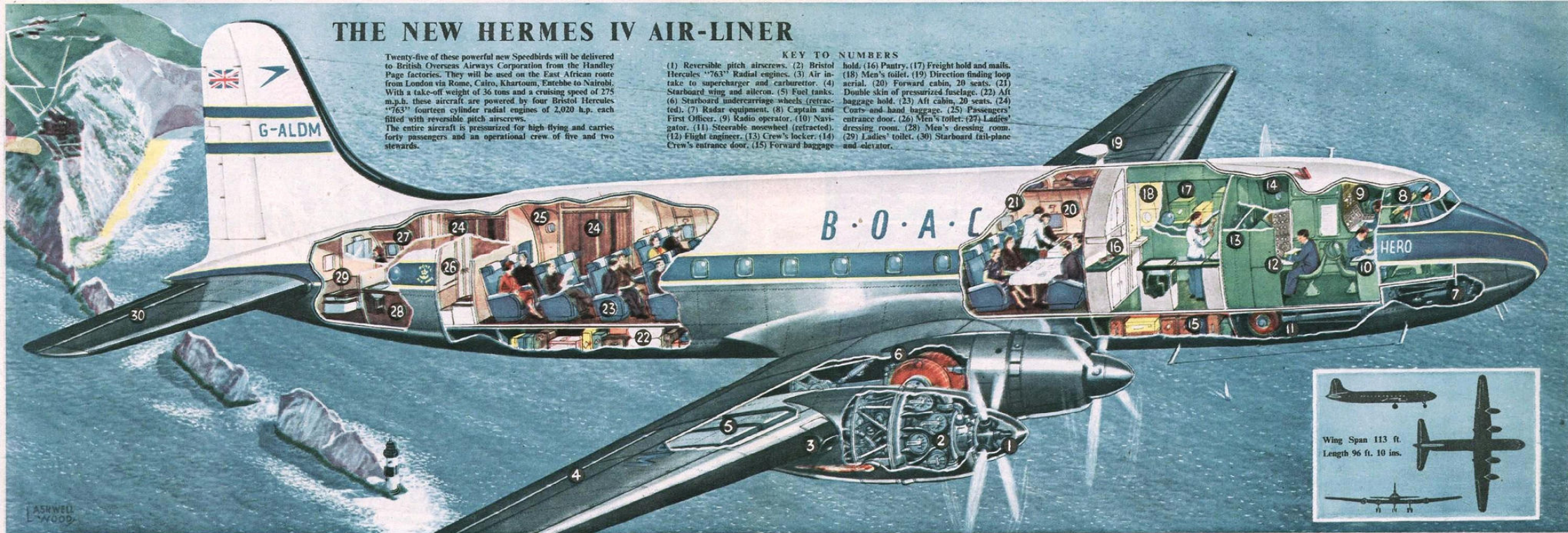
THE NEW HERMES IV AIR-LINER

Twenty-five of these powerful new Speedbirds will be delivered to British Overseas Airways Corporation from the Handley Page factories. They will be used on the East African route from London via Rome, Cairo, Khartoum, Entebbe to Nairobi. With a take-off weight of 36 tons and a cruising speed of 275 m.p.h. these aircraft are powered by four Bristol Hercules "763" fourteen cylinder radial engines of 2,020 h.p. each fitted with reversible pitch airscrews.

The entire aircraft is pressurized for high flying and carries forty passengers and an operational crew of five and two stewards.

KEY TO NUMBERS

- (1) Reversible pitch airscrews. (2) Bristol Hercules "763" Radial engines. (3) Air intake to supercharger and carburettor. (4) Starboard wing and aileron. (5) Fuel tanks. (6) Starboard undercarriage wheels (retracted). (7) Radar equipment. (8) Captain and First Officer. (9) Radio operator. (10) Navigator. (11) Steerable nosewheel (retracted). (12) Flight engineer. (13) Crew's locker. (14) Crew's entrance door. (15) Forward baggage hold. (16) Pantry. (17) Freight hold and mails. (18) Men's toilet. (19) Direction finding loop aerial. (20) Forward cabin, 20 seats. (21) Double skin of pressurized fuselage. (22) Aft baggage hold. (23) Aft cabin, 20 seats. (24) Coats and hand baggage. (25) Passengers' entrance door. (26) Men's toilet. (27) Ladies' dressing room. (28) Men's dressing room. (29) Ladies' toilet. (30) Starboard tail-plane and elevator.



R.A.F. BELVEDERE

The Westland Belvedere, of which R.A.F. Transport Command has several squadrons, is the largest and most capable helicopter in the Service. Some of the squadrons will be stationed in the Middle and Far East.

The Belvedere will perform lifting operations in tactical support of the Army. A load of 2½ tons can be carried internally or slung underneath. Typical loads are 19 troops or 12 stretcher cases, or a Land-Rover and trailer, or light-weight bridge slung underneath.

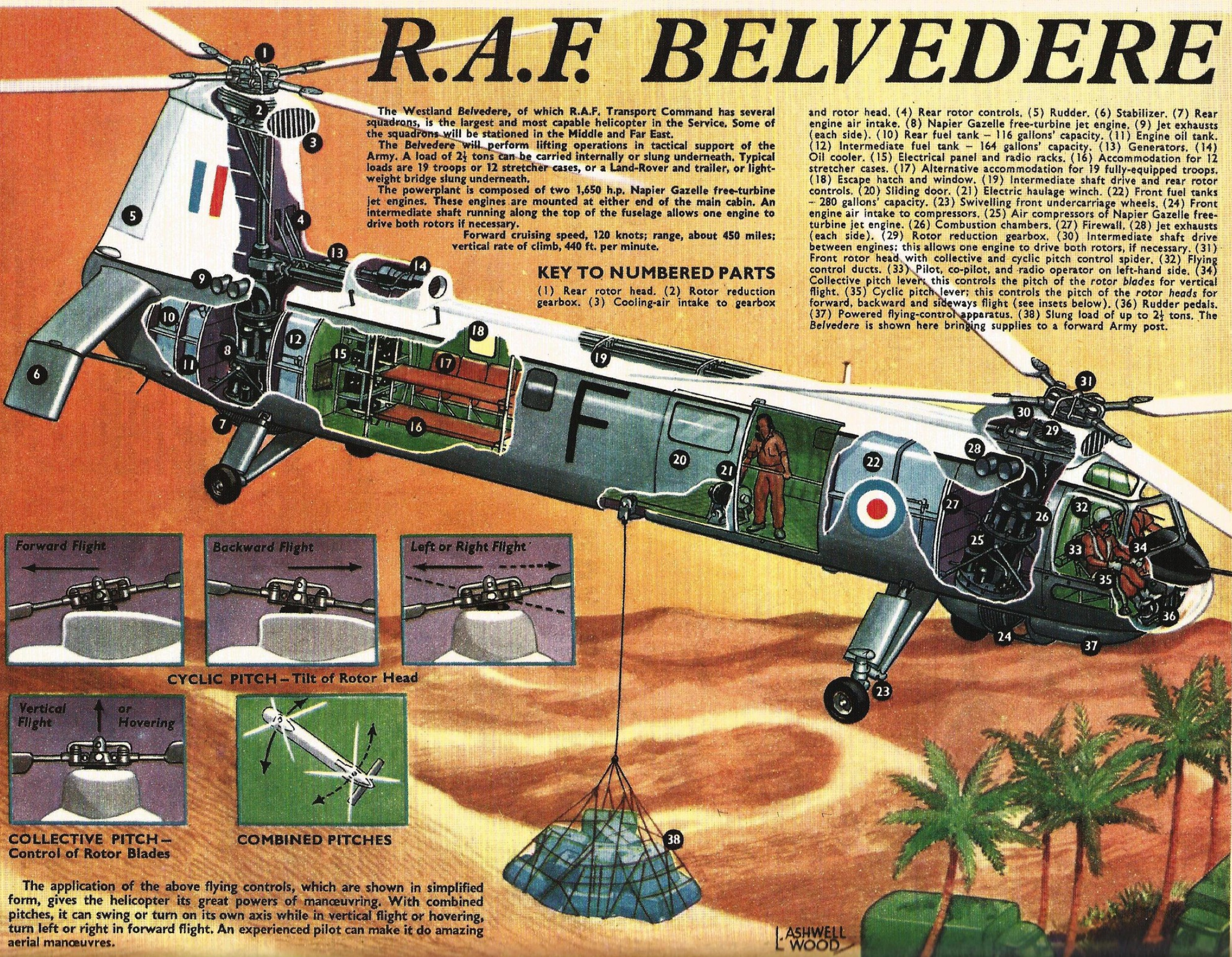
The powerplant is composed of two 1,650 h.p. Napier Gazelle free-turbine jet engines. These engines are mounted at either end of the main cabin. An intermediate shaft running along the top of the fuselage allows one engine to drive both rotors if necessary.

Forward cruising speed, 120 knots; range, about 450 miles; vertical rate of climb, 440 ft. per minute.

KEY TO NUMBERED PARTS

(1) Rear rotor head. (2) Rotor reduction gearbox. (3) Cooling-air intake to gearbox

and rotor head. (4) Rear rotor controls. (5) Rudder. (6) Stabilizer. (7) Rear engine air intake. (8) Napier Gazelle free-turbine jet engine. (9) Jet exhausts (each side). (10) Rear fuel tank - 116 gallons' capacity. (11) Engine oil tank. (12) Intermediate fuel tank - 164 gallons' capacity. (13) Generators. (14) Oil cooler. (15) Electrical panel and radio racks. (16) Accommodation for 12 stretcher cases. (17) Alternative accommodation for 19 fully-equipped troops. (18) Escape hatch and window. (19) Intermediate shaft drive and rear rotor controls. (20) Sliding door. (21) Electric haulage winch. (22) Front fuel tanks - 280 gallons' capacity. (23) Swivelling front undercarriage wheels. (24) Front engine air intake to compressors. (25) Air compressors of Napier Gazelle free-turbine jet engine. (26) Combustion chambers. (27) Firewall. (28) Jet exhausts (each side). (29) Rotor reduction gearbox. (30) Intermediate shaft drive between engines; this allows one engine to drive both rotors, if necessary. (31) Front rotor head with collective and cyclic pitch control spider. (32) Flying control ducts. (33) Pilot, co-pilot, and radio operator on left-hand side. (34) Collective pitch lever; this controls the pitch of the rotor blades for vertical flight. (35) Cyclic pitch lever; this controls the pitch of the rotor heads for forward, backward and sideways flight (see insets below). (36) Rudder pedals. (37) Powered flying-control apparatus. (38) Slung load of up to 2½ tons. The Belvedere is shown here bringing supplies to a forward Army post.



Forward Flight

Backward Flight

Left or Right Flight

CYCLIC PITCH - Tilt of Rotor Head

Vertical Flight or Hovering

COMBINED PITCHES

COLLECTIVE PITCH - Control of Rotor Blades

The application of the above flying controls, which are shown in simplified form, gives the helicopter its great powers of manoeuvring. With combined pitches, it can swing or turn on its own axis while in vertical flight or hovering, turn left or right in forward flight. An experienced pilot can make it do amazing aerial manoeuvres.

THE VICKERS 'WELLINGTON'

A FAMOUS WAR-TIME BOMBER

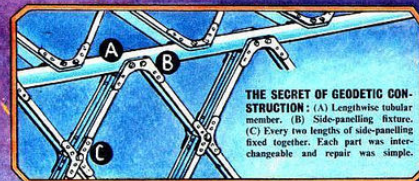
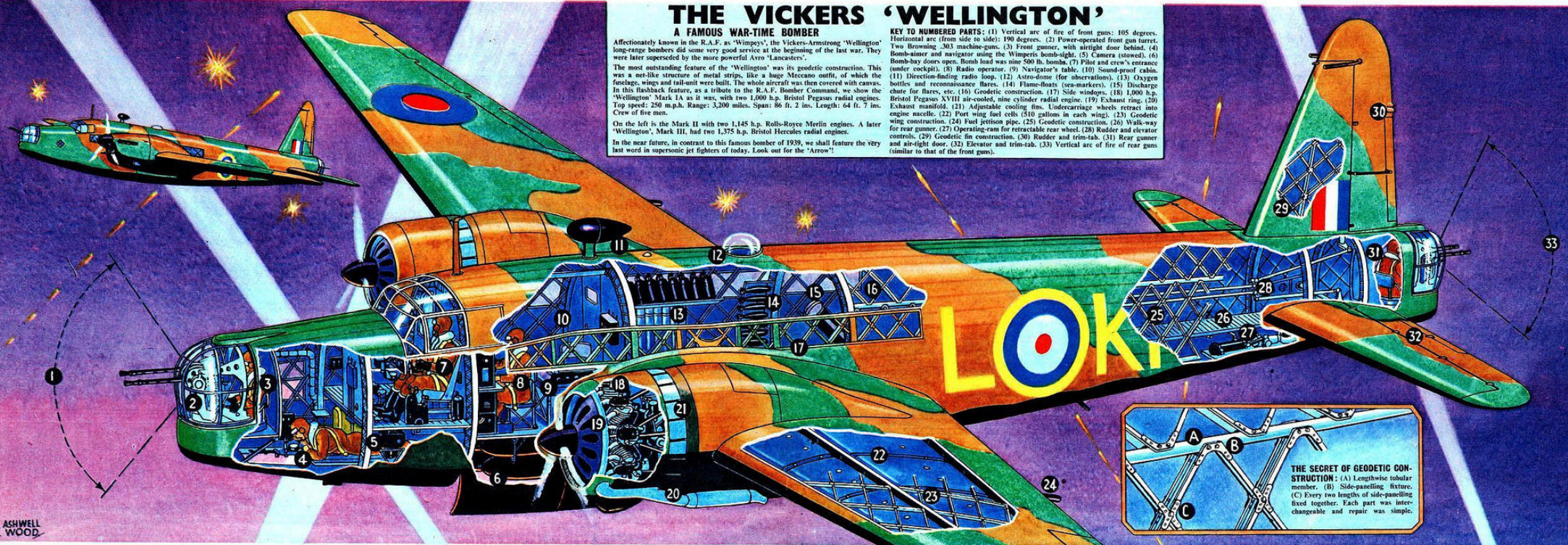
Affectionately known in the R.A.F. as 'Wimpeys', the Vickers-Armstrong 'Wellington' long-range bombers did some very good service at the beginning of the last war. They were later superseded by the more powerful Avro 'Lancasters'.

The most outstanding feature of the 'Wellington' was its geodetic construction. This was a net-like structure of metal strips, like a huge Meccano outfit, of which the fuselage, wings and tail-unit were built. The whole aircraft was then covered with canvas. In this flashback feature, as a tribute to the R.A.F. Bomber Command, we show the 'Wellington' Mark IA as it was, with two 1,000 h.p. Bristol Pegasus radial engines. Top speed: 250 m.p.h. Range: 3,200 miles. Span: 86 ft. 2 ins. Length: 64 ft. 7 ins. Crew of five men.

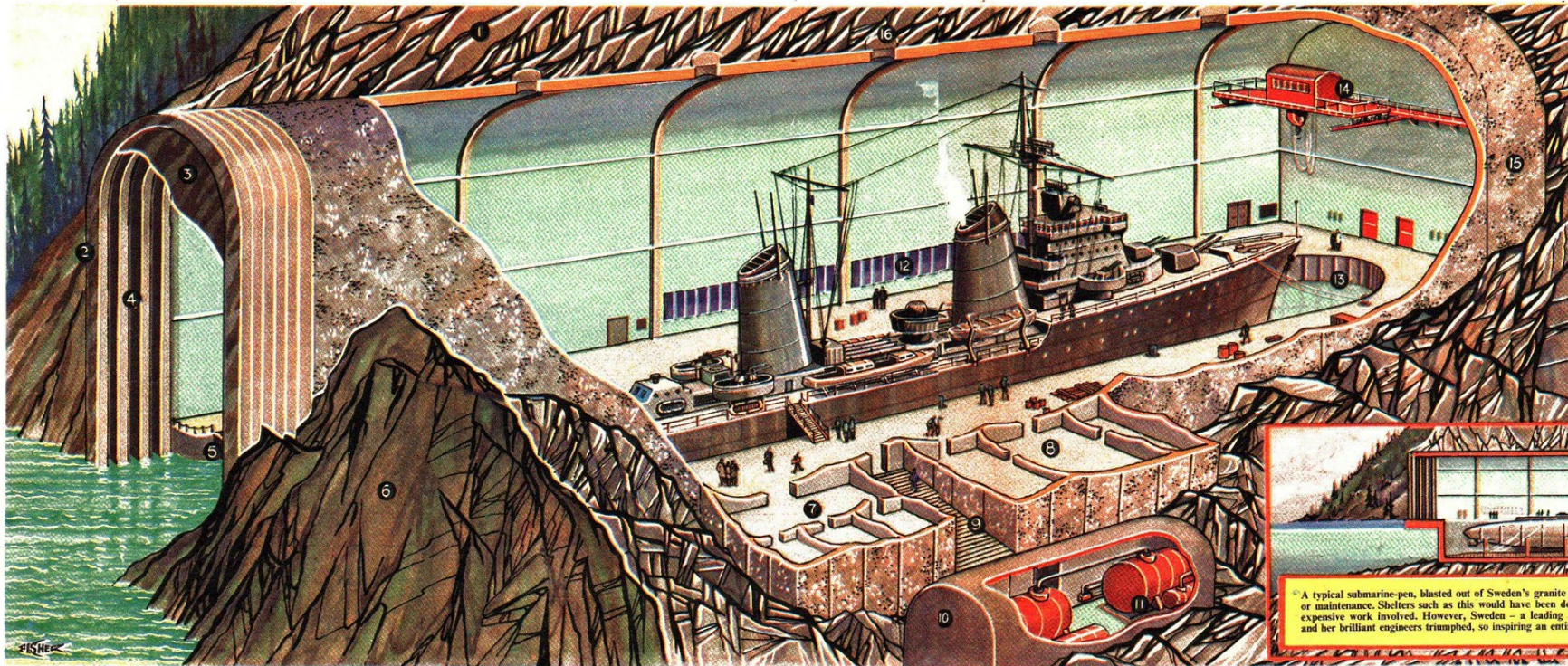
On the left is the Mark II with two 1,145 h.p. Rolls-Royce Merlin engines. A later 'Wellington', Mark III, had two 1,375 h.p. Bristol Hercules radial engines.

In the near future, in contrast to this famous bomber of 1939, we shall feature the very last word in supersonic jet fighters of today. Look out for the 'Arrow'!

KEY TO NUMBERED PARTS: (1) Vertical arc of fire of front guns: 105 degrees. Horizontal arc (from side to side): 190 degrees. (2) Power-operated front gun turret. Two Browning .303 machine-guns. (3) Front gunner, with airtight door behind. (4) Bomb-aimer and navigator using the Wimpeys bomb-sight. (5) Camera (stowed). (6) Bomb-bay doors open. Bomb load was nine 500 lb. bombs. (7) Pilot and crew's entrance (under cockpit). (8) Radio operator. (9) Navigator's table. (10) Sound-proof cabin. (11) Direction-finding radio loop. (12) Astro-dome (for observations). (13) Oxygen bottles and reconnaissance flares. (14) Flame-floats (sea-markers). (15) Discharge chute for flares, etc. (16) Geodetic construction. (17) Side windows. (18) 1,000 h.p. Bristol Pegasus XVIII air-cooled, nine cylinder radial engine. (19) Exhaust ring. (20) Exhaust manifold. (21) Adjustable cooling fins. Undercarriage wheels retract into engine nacelle. (22) Port wing fuel cells (510 gallons in each wing). (23) Geodetic wing construction. (24) Fuel jettison pipe. (25) Geodetic construction. (26) Walk-way for rear gunner. (27) Operating-ram for retractable rear wheel. (28) Rudder and elevator controls. (29) Geodetic fin construction. (30) Rudder and trim-tab. (31) Rear gunner and airtight door. (32) Elevator and trim-tab. (33) Vertical arc of fire of rear guns (similar to that of the front guns).



THE SECRET OF GEODETIC CONSTRUCTION: (A) Lengthwise tubular member. (B) Side-panelling fixture. (C) Every two lengths of side-panelling fixed together. Each part was interchangeable and repair was simple.



UNDERGROUND SHELTERS FOR SWEDEN'S NAVY

By tunnelling into the steep, rocky slopes of her coastlines, Sweden is providing a system of underground shelters for her Navy. Millions of cubic feet of granite have been blasted away to form these well-hidden retreats, and the work has been proceeding steadily since the end of World War II. Docks, storage areas, workshops and repair depots, as well as living quarters for personnel, are all included in the scheme.

The entrances to these docks are camouflaged well enough to make them almost invisible, against the pine-clad slopes in which they are built. In this age of atomic and hydrogen weapons, their invulnerable position is very obvious. As a further protection, the gateways and pockets have been blasted at oblique angles into the solid granite, to avoid possible damage to the tunnels by impact of air or water pressure during an enemy attack. The docks can house destroyers.

KEY TO NUMBERS

- (1) Solid granite. (2) Camouflaged entrance. (3) Camouflaged sliding-doors. (4) Anti-blast screens. (5) Dock gate. (6) Outer rock-face. (7) Workshop area. (8) Stores area. (9) Ramp leading to fuel-tank tunnel. (10) Tunnel housing fuel-tanks constructed at a lower level than main dock tunnel. (11) Fuel-tanks. (12) Stores, pump-rooms and workshops. (13) Dock basin, from which the water can be pumped if necessary, leaving the vessel 'in the dry' for repair or maintenance to the hull, etc. (14) Travelling gantry-hoist. (15) Reinforced concrete structure. (16) Ventilating system.



A typical submarine-pen, blasted out of Sweden's granite coastline, provides a safe shelter for underwater craft while undergoing repairs or maintenance. Shelters such as this would have been deemed an impossible undertaking a few years ago, because of the tedious and expensive work involved. However, Sweden - a leading pioneer in this type of construction - evolved new equipment and techniques, and her brilliant engineers triumphed, so inspiring an entirely new concept of underground engineering.

BRITAIN'S 52-TON SUPER TANK

The *Centurion* is the last word in modern tank design and, from a mechanical point of view, is a fine piece of engineering. The tank is powered by a 635 h.p. *Meteor* petrol engine, an adaptation of the famous Rolls-Royce *Merlin* aero-engine, and has a top speed of 25 m.p.h. The secret, gyroscopic stabilized fire control system trains the 20-pounder gun on any target, no matter how violently the tank may move.

KEY TO PARTS

(1) 20-pounder quick-firing gun. (2) 7.92 mm. Besa machine-gun. (3) Smoke-screen grenade dischargers. (4) Driver's periscopes and hatch. (5) Driver on right-hand side of tank. (6) Track steering controls. (7) Gear change lever. There are five forward speeds and two reverse. (8) Frontal armour. (9) Right-hand track. The tank is steered by controlling the respective speeds of the tracks; if one is locked stationary the other will turn the tank on its own axis. (10) Left-hand track. (11) Track idling wheel. (12) Suspended bogie wheels, which take the entire weight on the tracks. (13) Boxes containing portable cooker, rations, etc. (14) Turntable turret floor. (15) Compressed air reservoir for turning turret. (16) Bin for spent shell cases. (17) Power traverse for turning turret. (18) Turret armour. (19) Gun loader. (20) Commander. (21) Gunner or controller. (22) Gunner's and loader's periscopes. (23) Commander's periscope and opening cupola. (24) Whip radio aerials. (25) Radio and inter-com telephone and microphone. (26) Twenty-pounder ammunition. (27) Lifting jacks and turret cover in box. (28) Signal flare. (29) Spare track links. (30) Engine fire-proof bulkhead and access door. (31) Vee 12-cylinder, 635 h.p. *Meteor* IVA engine. (32) Outside exhaust pipe. (33) Air filters and connection to rear radiator. (34) Combined gearbox and track steering unit, coupled to the main engine clutch. (35) Track speed operating arms. (36) Left-hand track clutch and brake drums. (37) Final reduction gearing to driving sprocket. (38) Track driving sprocket. (39) Left-hand fishtail exhaust outlet.

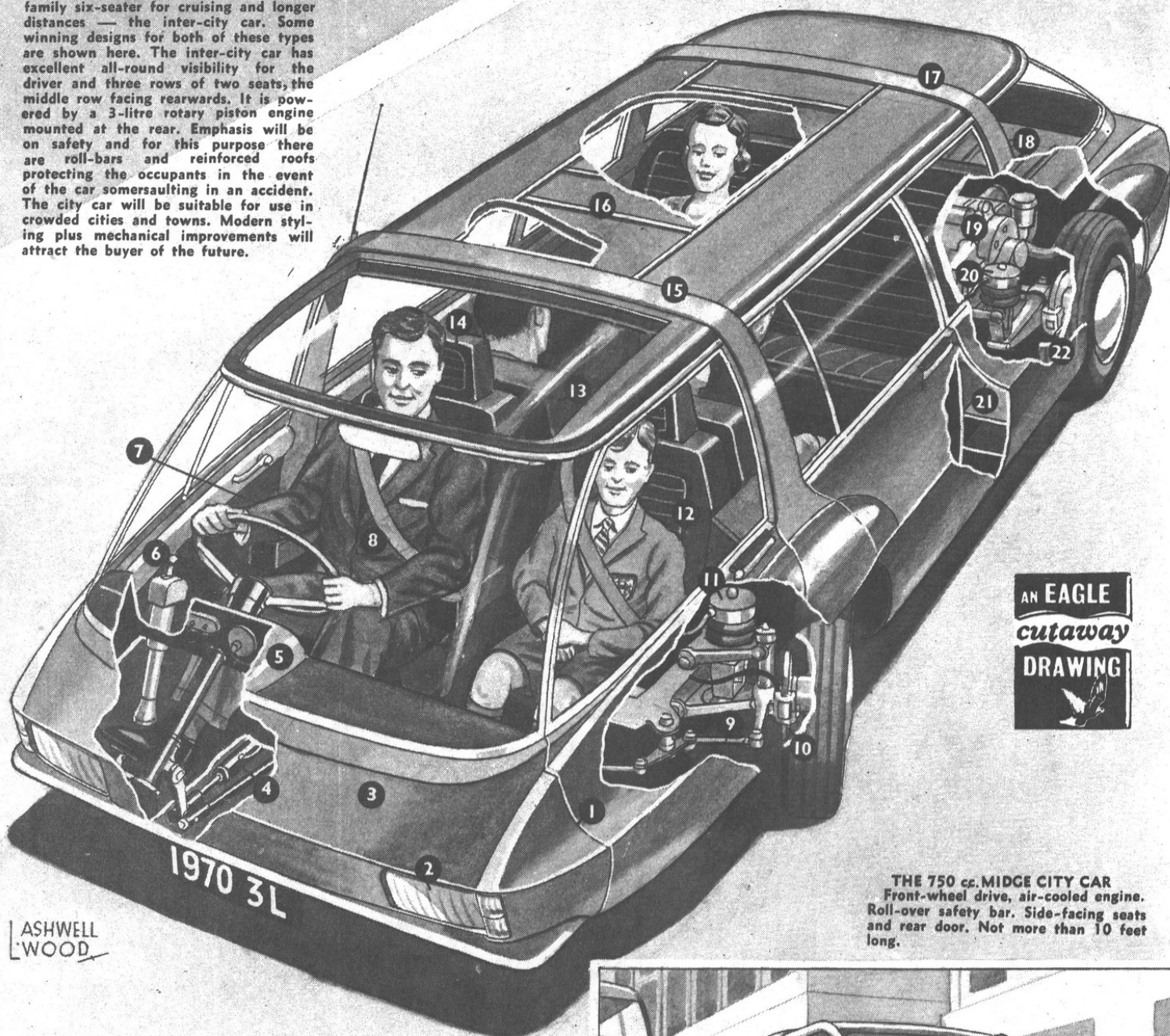


The tank using its stabilized fire control system for elevation.

Stabilized fire control system for traverse. The gun automatically trains on the target irrespective of the tank's movements.

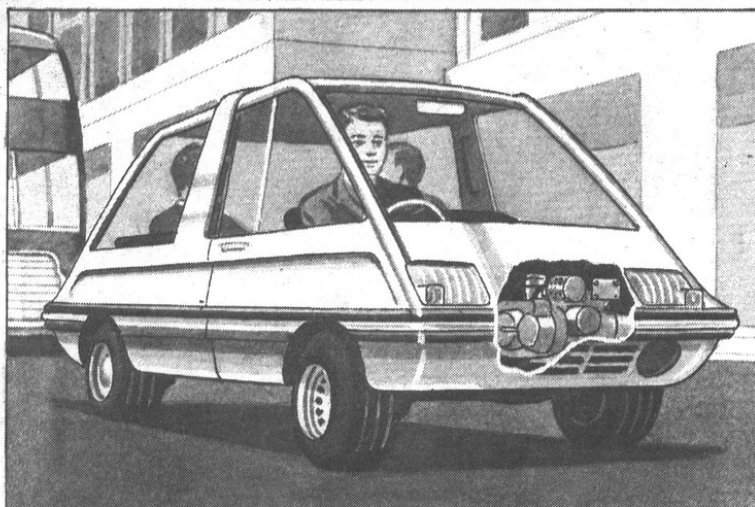
CARS OF TOMORROW

In a recent car-styling competition many designs were submitted for the cars of the future. More and more of our daily motoring seems to be concerned with relatively short, local journeys, so there will be cars designed for this need — the city car. On the other hand there will be a demand for the family six-seater for cruising and longer distances — the inter-city car. Some winning designs for both of these types are shown here. The inter-city car has excellent all-round visibility for the driver and three rows of two seats, the middle row facing rearwards. It is powered by a 3-litre rotary piston engine mounted at the rear. Emphasis will be on safety and for this purpose there are roll-bars and reinforced roofs protecting the occupants in the event of the car somersaulting in an accident. The city car will be suitable for use in crowded cities and towns. Modern styling plus mechanical improvements will attract the buyer of the future.



THE 750 cc. MIDGE CITY CAR
Front-wheel drive, air-cooled engine.
Roll-over safety bar. Side-facing seats
and rear door. Not more than 10 feet
long.

Key to numbered features of the inter-city car
1. Large front doors. 2. Built-in headlamps. 3. Low frontal styling.
4. Power-assisted steering. 5. Instrument panel. 6. Finger-tip automatic gear change. 7. Large clear-view windscreen and front roof of anti-glare flexible glass. 8. Safety belts. 9. Link steering. 10. Disc brakes. 11. Air-cushion suspension. 12. Staggered front seat allowing driver free movement. 13. Rearwards-facing seats. 14. Headrest protects head from being flung backwards in event of a severe bump from behind. 15. Front roll-over bar. 16. Reinforced roof. 17. Rear roll-over bar. 18. Luggage space. 19. 3-litre rotating piston engine. 20. Air-cushion suspension. 21. Recess in sides for light articles. 22. Disc brakes.



This is the fourth in our series of British Railway Steam Locomotives and is one of a numerous class designed for mixed traffic work; that is, for heavy freight haulage and also for running fast passenger trains with their 6 ft. 2 ins. driving wheels. Thus, their days can be filled up usefully with a variety of duties. The wheel arrangement is 4-6-0 and the boiler pressure 225 lb. per sq. in. with two outside cylinders. The locomotive shown here is coaling up at the coaling tower, the coal capacity of the tender being 7 tons.

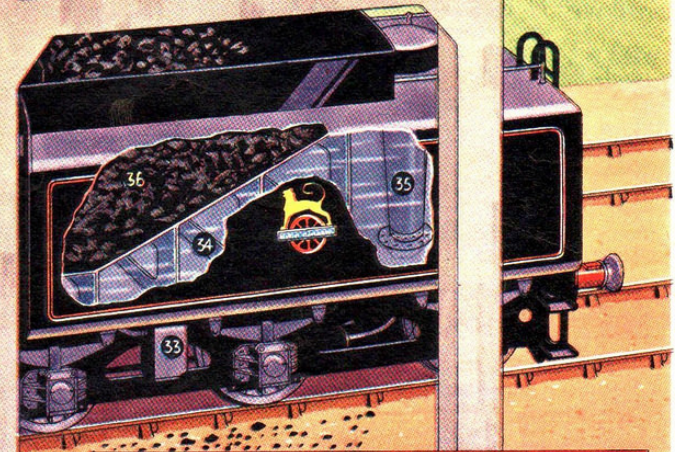
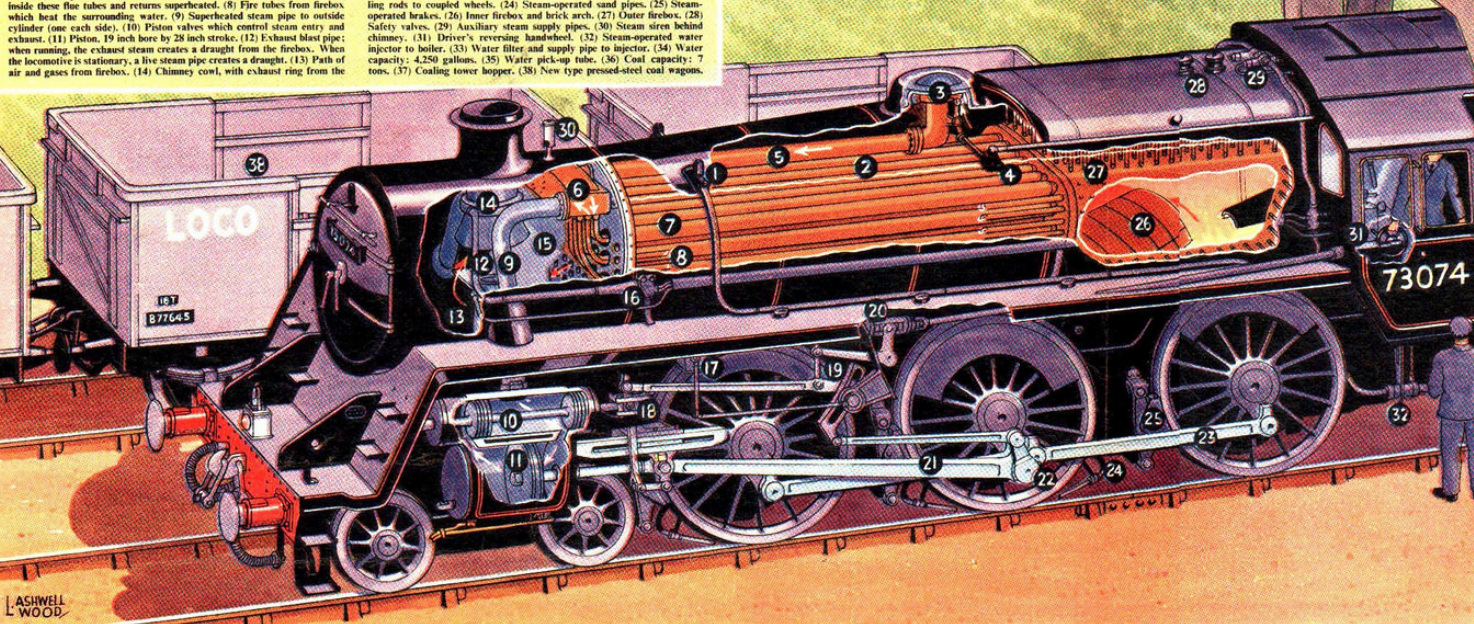
KEY TO HOW IT WORKS

(1) Boiler feed water valves (each side). (2) Water level in boiler and over firebox. (3) Steam rises to this dome and is admitted by the regulator valve to main steam pipe. (4) Outside regulator rod. (5) Main steam pipe to superheater. (6) Superheater header. (7) Steam passes back into boiler via pipes inside these flue tubes and returns superheated. (8) Fire tubes from firebox, which heat the surrounding water. (9) Superheated steam pipe to outside cylinder (one each side). (10) Piston valves which control steam entry and exhaust. (11) Piston, 19 inch bore by 28 inch stroke. (12) Exhaust blast pipe; when running, the exhaust steam creates a draught from the firebox. When the locomotive is stationary, a live steam pipe creates a draught. (13) Path of air and gases from firebox. (14) Chimney cowl, with exhaust ring from the

vacuum brake ejector. (15) Spark arrester plate. (16) Steam-operated vacuum brake ejector. (17) Mechanical lubricator. (18) Radius rod working piston valves. (19) Reversing link of Walschaert valve gear, shown here in reverse gear. (20) Reversing gear from driver's handwheel. (21) Connecting rod to driving wheel. (22) Return crank operating reversing link. (23) Coupling rods to coupled wheels. (24) Steam-operated sand pipes. (25) Steam-operated brakes. (26) Inner firebox and brick arch. (27) Outer firebox. (28) Safety valves. (29) Auxiliary steam supply pipes. (30) Steam siren behind chimney. (31) Driver's reversing handwheel. (32) Steam-operated water injector to boiler. (33) Water filter and supply pipe to injector. (34) Water capacity: 4,250 gallons. (35) Water pick-up tube. (36) Coal capacity: 7 tons. (37) Coaling tower hopper. (38) New type pressed-steel coal wagons.

BRITISH RAILWAYS CLASS '5'

(MIXED TRAFFIC LOCOMOTIVE)



BRITISH RAILWAYS STANDARD CLASS '5' MIXED TRAFFIC
Two-cylinder 4-6-0 locomotive. Weight in working order: 76 tons 4 cwt. Tender: 47 tons 4 cwt. Total: 123 tons 8 cwt.

THE FUTURE GAS-TURBOCAR

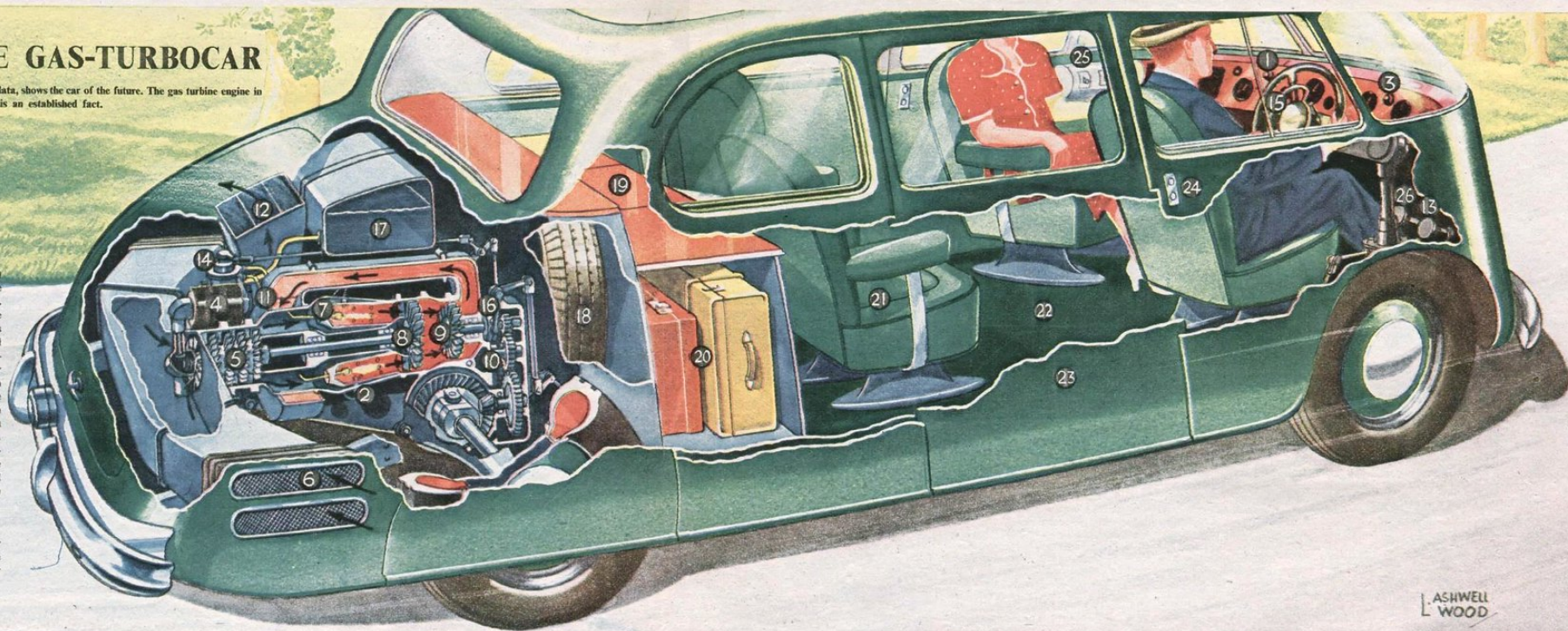
Our artist's conception, based on scientific data, shows the car of the future. The gas turbine engine in a car is an established fact.

KEY TO CYCLE OF OPERATIONS

The ignition is switched on (1) and the igniting plug (2) comes into operation. The starter button (3) operates the starting motor (4) which turns over the compressor (5). This sucks in air through the filters (6) and passes it to the combustion chambers (7). Fuel is sprayed in and mixes with the compressed air, which becomes flaming gas and drives the turbine wheel (8) which now drives the compressor (5). The engine is now running and the starter motor and ignition are cut out. A second turbine (9), on an independent shaft, is driven by the escaping gas from the first turbine and drives the back axle through reduction gearing (10). The hot gases pass to a preheater (11) which heats the incoming air and passes it to the exhaust (12). The speed of the first turbine is controlled by an accelerator (13) and fuel pump (14). This controls the speed of the second turbine and thus that of the car. The clutch control (15) disconnects the drive to the back axle by a clutch (16) when car is stationary, but engine running.

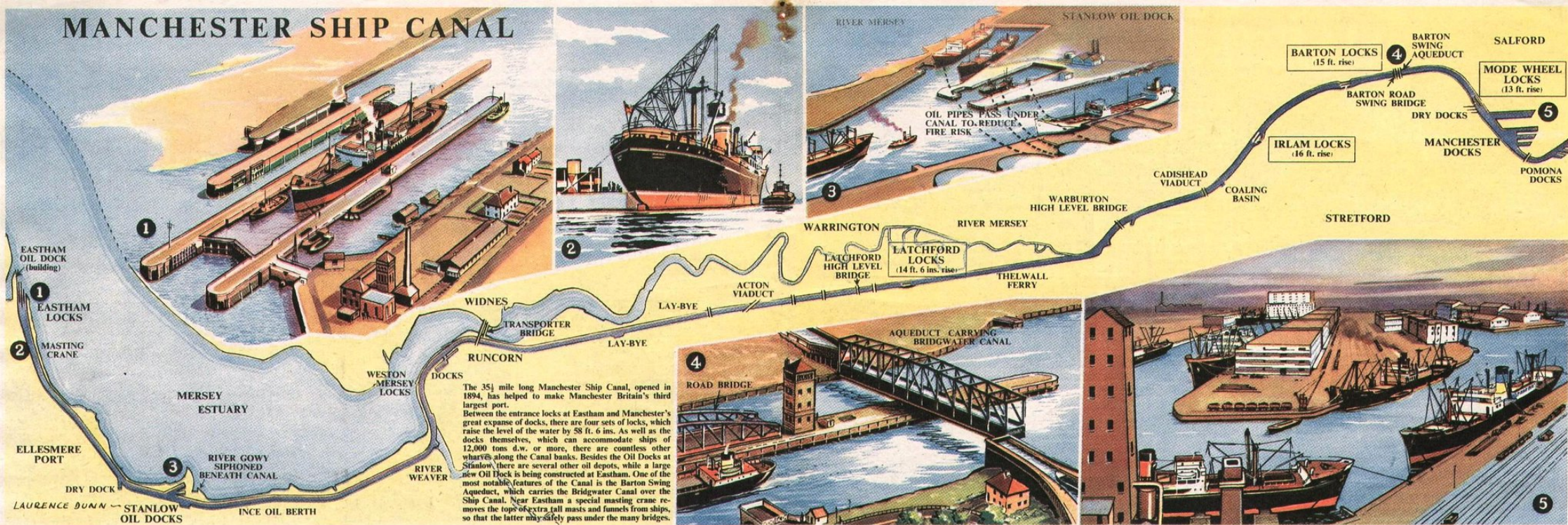
KEY TO PARTS

(17) fuel tank, (18) spare wheel, (19) occasional table or folding seat, (20) luggage space, (21) new type moveable seats, (22) full leg room, (23) sliding door, (24) door control, (25) humidity control, (26) brake pedal.



L. ASHWELL
WOOD

MANCHESTER SHIP CANAL



A BUSY MODERN CIVIL AIRPORT

Ferryfield airport at Lydd, near Dungeness on the Kent coast, is the first British civil airport to have been built since the end of the war. It is owned by Silver City Airways, who also operate their own fleet of Bristol Superfreighter aircraft on the car ferry service to Le Touquet, France.

This is a fast air ferry for passengers to the Continent and their cars, the flight time over the Channel being only 20 minutes.

Ferryfield is the third busiest airport in Britain (London Airport is the largest and Jersey, Channel Isles, the second largest). In the peak holiday period, three cars and fourteen passengers per aircraft are taken on every 15 minutes. Sixty flights may be made on a busy day, a truly remarkable achievement.

In the drawing we show the complete layout of the airport and the sequence of departure and arrival. In next week's issue we shall show a close-up of a Bristol Superfreighter with the cars inside.

KEY TO SEQUENCE OF DEPARTURE:

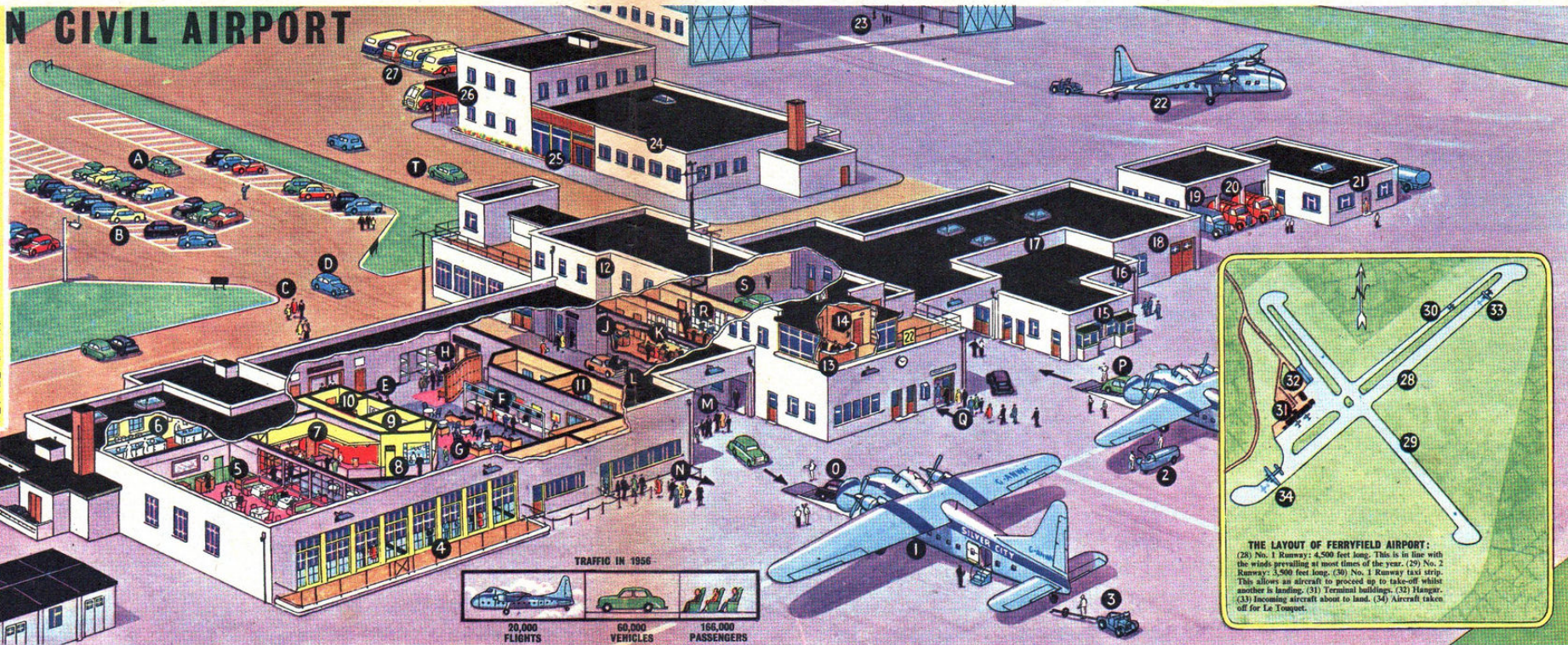
(A) Car and passengers arrive at Ferryfield. (B) Car park. (C) Passengers leave car and proceed to terminal building. (D) Cars are handed over to official drivers. (E) Passengers report to A.A. or R.A.C. (F) Passengers go to traffic counter with tickets, etc. (G) Passengers wait in lounge, buffet bar or restaurant until told by loudspeaker to assemble for their flight. (H) Official guide assembles the passengers named. (J) Passengers proceed to passport examination. (K) Customs examination. (L) Passengers cars are checked for customs, engine numbers taken, etc. (M) Passengers proceed to forward waiting room whilst their cars are loaded into aircraft. (N) Passengers proceed to take their seats in aircraft. (O) Cars being loaded.

KEY TO SEQUENCE OF ARRIVAL FROM LE TOUQUET:

(P) Cars being unloaded. (Q) Passengers proceed to customs. (R) Incoming passengers' customs examination. (S) Passengers rejoin their cars. (T) Cars and passengers leave Ferryfield.

KEY TO AIRPORT:

(1) Bristol Superfreighter being loaded on the tarmac. (2) Refuelling begins immediately after cars are unloaded. (3) Towing truck ready to haul loaded aircraft rear-wards and turn to face the runway taxi strip. (4) Observation lounge and terrace. (5) Restaurant. (6) Kitchens. (7) Buffet bar. (8) Shop. (9) Bank. (10) A.A. and R.A.C. counters. (11) Traffic office. Here the length of every known car is carefully worked out for loading. (12) Administration offices. (13) Control tower. (14) Radar room. (15) Station operations room. (16) Aircraft's room. (17) Official quarters. (18) Freight department. (19) Ambulance. (20) Fire engines. (21) Ground crew's canteen. (22) Aircraft towed to hanger for maintenance check. (23) Hanger for three aircraft. (24) Air cruise building. Apart from the car ferry service, passenger-only air trips are made from the airport in other aircraft. (25) Air cruise lounge and cafeteria. (26) Air cruise passenger entrance. (27) Air cruise coach and car park.



TRAFFIC IN 1956

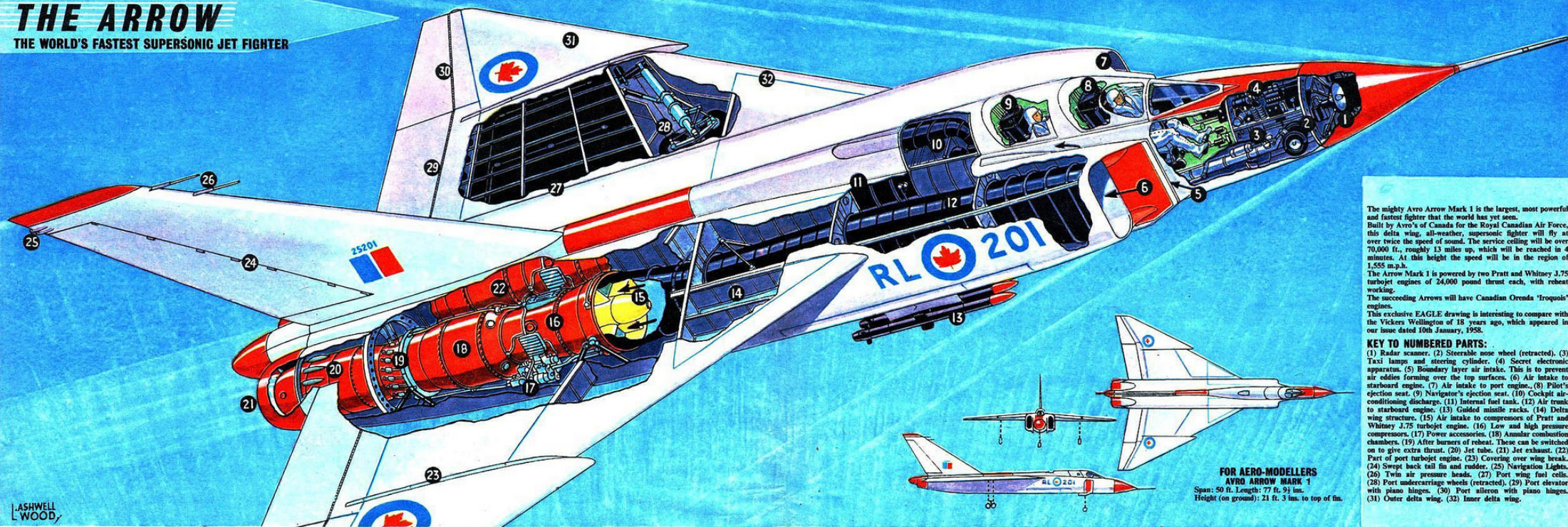


THE LAYOUT OF FERRYFIELD AIRPORT:

(28) No. 1 Runway: 4,500 feet long. This is in line with the winds prevailing at most times of the year. (29) No. 2 Runway: 3,500 feet long. (30) No. 1 Runway taxi strip. This allows an aircraft to proceed up to take-off whilst another is landing. (31) Terminal buildings. (32) Hanger. (33) Incoming aircraft about to land. (34) Aircraft taken off for Le Touquet.

THE ARROW

THE WORLD'S FASTEST SUPERSONIC JET FIGHTER



The mighty Avro Arrow Mark 1 is the largest, most powerful and fastest fighter that the world has yet seen.

Built by Avro's of Canada for the Royal Canadian Air Force, this delta wing, all-weather, supersonic fighter will fly at over twice the speed of sound. The service ceiling will be over 70,000 ft., roughly 13 miles up, which will be reached in 4 minutes. At this height the speed will be in the region of 1,555 m.p.h.

The Arrow Mark 1 is powered by two Pratt and Whitney J.75 turbojet engines of 24,000 pound thrust each, with reheat working.

The succeeding Arrows will have Canadian Orenda 'Iroquois' engines.

This exclusive EAGLE drawing is interesting to compare with the Vickers Wellington of 18 years ago, which appeared in our issue dated 10th January, 1958.

KEY TO NUMBERED PARTS:

(1) Radar scanner. (2) Steerable nose wheel (retracted). (3) Taxi lamps and steering cylinder. (4) Secret electronic apparatus. (5) Boundary layer air intake. This is to prevent air eddies forming over the top surfaces. (6) Air intake to starboard engine. (7) Air intake to port engine. (8) Pilot's ejection seat. (9) Navigator's ejection seat. (10) Cockpit air-conditioning discharge. (11) Internal fuel tank. (12) Air trunk to starboard engine. (13) Guided missile racks. (14) Delta wing structure. (15) Air intake to compressors of Pratt and Whitney J.75 turbojet engine. (16) Low and high pressure compressors. (17) Power accessories. (18) Annular combustion chambers. (19) After burners of reheat. These can be switched on to give extra thrust. (20) Jet tube. (21) Jet exhaust. (22) Part of port turbojet engine. (23) Covering over wing break. (24) Swept back tail fin and rudder. (25) Navigation Lights. (26) Twin air pressure heads. (27) Port wing fuel cells. (28) Port undercarriage wheels (retracted). (29) Port elevator with piano hinges. (30) Port alleron with piano hinges. (31) Outer delta wing. (32) Inner delta wing.

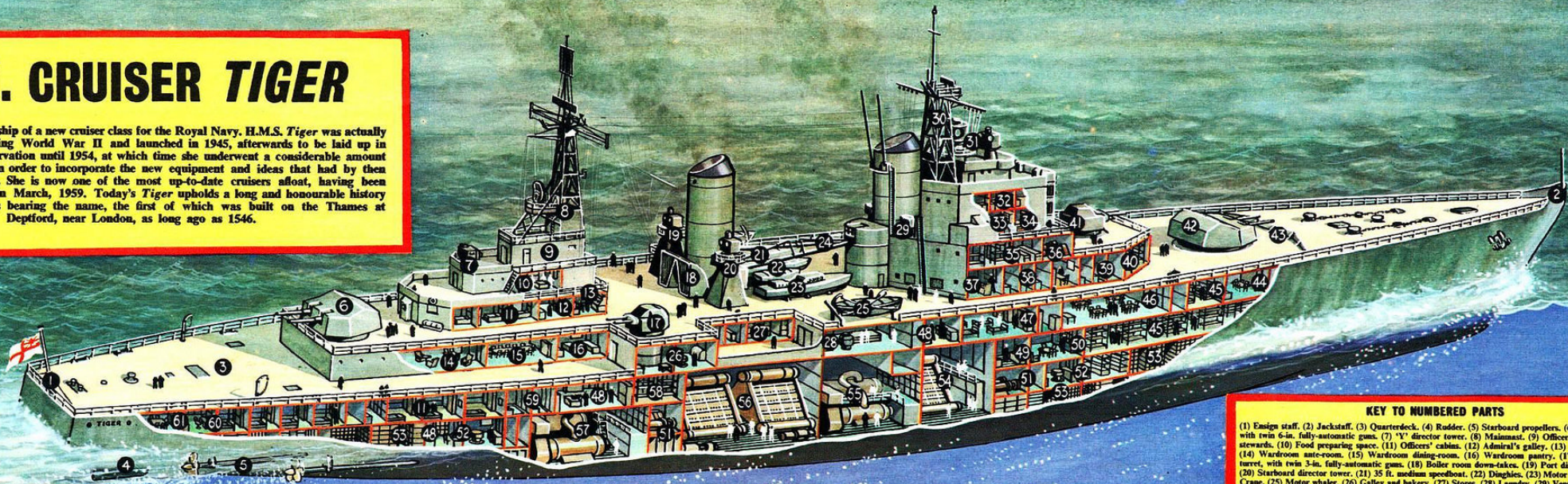
FOR AERO-MODELLERS

AVRO ARROW MARK 1

Span: 50 ft. Length: 77 ft. 9½ in.
Height (on ground): 21 ft. 3 in. to top of fin.

H.M. CRUISER *TIGER*

This is the first ship of a new cruiser class for the Royal Navy. H.M.S. *Tiger* was actually laid down during World War II and launched in 1945, afterwards to be laid up in a state of preservation until 1954, at which time she underwent a considerable amount of re-planning in order to incorporate the new equipment and ideas that had by then been developed. She is now one of the most up-to-date cruisers afloat, having been commissioned in March, 1959. Today's *Tiger* upholds a long and honourable history of British ships bearing the name, the first of which was built on the Thames at Deptford, near London, as long ago as 1546.



KEY TO NUMBERED PARTS

(1) Ensign staff. (2) Jackstaff. (3) Quarterdeck. (4) Rudder. (5) Starboard propellers. (6) 'Y' turret, with twin 6-in. fully-automatic guns. (7) 'Y' director tower. (8) Mainmast. (9) Officers' cooks and stewards. (10) Food preparing space. (11) Officers' cabins. (12) Admiral's galley. (13) Radio room. (14) Wardroom ante-room. (15) Wardroom dining-room. (16) Wardroom pantry. (17) Starboard turret, with twin 3-in. fully-automatic guns. (18) Boiler room down-takes. (19) Port director tower. (20) Starboard director tower. (21) 35 ft. medium speedboat. (22) Dinghies. (23) Motor pinnacle. (24) Crane. (25) Motor whaler. (26) Galley and bakery. (27) Stores. (28) Laundry. (29) Vents. (30) Foremast. (31) Director towers. (32) Gunnery control stations. (33) Wireless room. (34) Sea cabins. (35) C.P.O.s' mess. (36) Fans. (37) P.O.s' mess. (38) C.P.O.s' baths. (39) Entrance. (40) Messdeck. (41) Forward turret, with twin 3-in. fully-automatic guns. (42) 'A' turret, with twin 6-in. fully-automatic guns. (43) Breakwater. (44) Writers' messdeck. (45) Seamen's messdecks. (46) Junior ratings' dining-hall. (47) Sick bay. (48) Offices. (49) Baths. (50) Recreation space. (51) Auxiliary machinery. (52) Gyro rooms. (53) Stores. (54) Forward boiler room. (55) Forward starboard turbines. (56) After boiler room. (57) After starboard turbines; largely automatic, and can be remotely controlled. (58) Engineer mechanics' mess. (59) Officers' baths. (60) Captain's quarters. (61) Admiral's quarters.

A SPECIAL SHIP FOR DIVERS

Built for the Admiralty for deep diving and submarine rescue work, H.M.S. "Reclaim" is the tender attached to Vernon Shore Establishment. She is designed to carry 15 divers and the latest word in deep diving equipment. Displacement is 1,700 tons with two triple expansion steam engines of 1,500 h.p., giving her a speed of 12 knots. Oil-fired Scotch boilers. Crew 84. Length 218 ft. Breadth 38 ft.

KEY TO NUMBERS

(1) Winch for bow anchors. (Port anchor dropped). (2) Naval stores. (3) Asdic instrument room. (4) Asdic dome. The oscillator projects from the bottom of the ship and sends out high frequency supersonic waves in all directions to form return message signals. (5) Low-pressure air reservoirs. (6) Deep diving and decompression chambers. (7) Diving door. (Port and Starboard). (8) Oxy-helium panel for simplifying divers breathing at great depths. (9) Recompression chambers which divers enter on surfacing to adjust them to normal pressure. (10) Recompression chamber controls. (11) Foremast and booms. (12) Direction finding aerial. (13) Upper bridge. (14) Navigating bridge. (15) Diving gear equipment and stores. (16) Refrigerating machinery. (17) Refrigerated stores. (18) Submarine observation cylinder being lowered. (19) New television camera for recording underwater objects. (20) Oil fuel tanks. (21) Scotch boiler room. (22) 25 ft. Whaler. (23) Carley floats or rafts. (24) 28 ft. launch. (25) Engine room hatch. (26) Mainmast with boom for handling launches. (27) Vegetable store. (28) 30 ft. divers' launch. (29) Stokers' quarters. (30) Engine room; two triple expansion steam engines. (31) Port propeller shaft tunnel. (32) Seamen's mess. (33) Seamen's quarters. (34) Winch for stern anchors. (35) Stern anchors (port anchor dropped). (36) Port propeller. (37) Mooring vessel. (38) Wreck marker buoys.

Submarine Observation Cylinder can be operated at great depths and for long periods at controlled atmospheric pressure. (A) Lifting and lowering chains and cable. (B) Telephone cable. (C) Entrance cover door. (D) Telephone release gear. (E) Gauges and anchor weight release gear. (F) Observation windows. (G) Breathing apparatus. (H) Revolving seat. (I) Oxygen cylinder. (J) Anchor weight winch. (K) Removable anchor weight enables operator to anchor himself to the sea bed at any desired height. (L) Independent lamp lowered for observation.

H.M.S. EXPLORER – THE WORLD'S FASTEST SUBMARINE

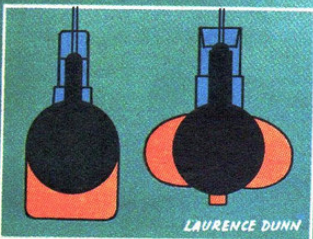
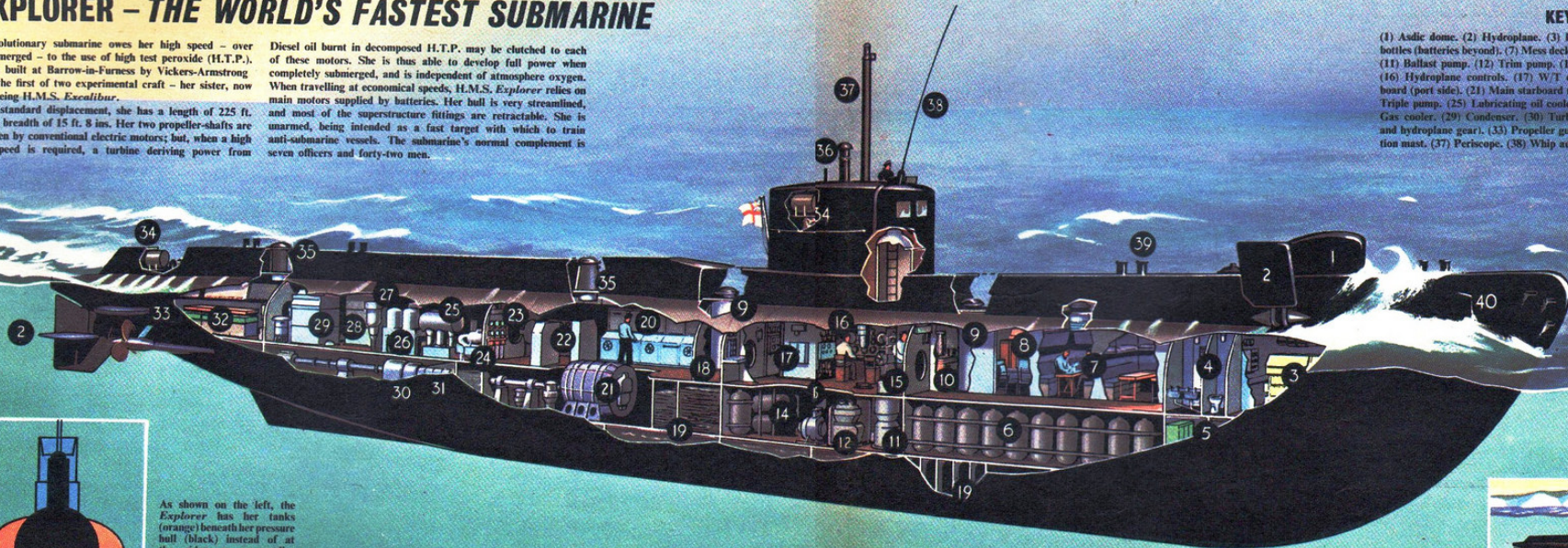
Britain's revolutionary submarine owes her high speed – over 25 knots submerged – to the use of high test peroxide (H.T.P.). She has been built at Barrow-in-Furness by Vickers-Armstrong Ltd., and is the first of two experimental craft – her sister, now completing, being H.M.S. *Excalibur*.

Of 780 tons standard displacement, she has a length of 225 ft. 6½ ins., and a breadth of 15 ft. 8 ins. Her two propeller-shafts are normally driven by conventional electric motors; but, when a high underwater speed is required, a turbine deriving power from

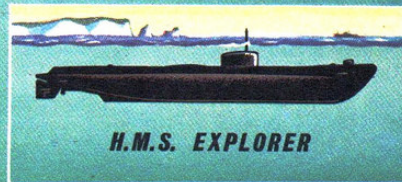
Diesel oil burnt in decomposed H.T.P. may be clutched to each of these motors. She is thus able to develop full power when completely submerged, and is independent of atmosphere oxygen. When travelling at economical speeds, H.M.S. *Explorer* relies on main motors supplied by batteries. Her hull is very streamlined, and most of the superstructure fittings are retractable. She is unarmed, being intended as a fast target with which to train anti-submarine vessels. The submarine's normal complement is seven officers and forty-two men.

KEY TO NUMBERS:

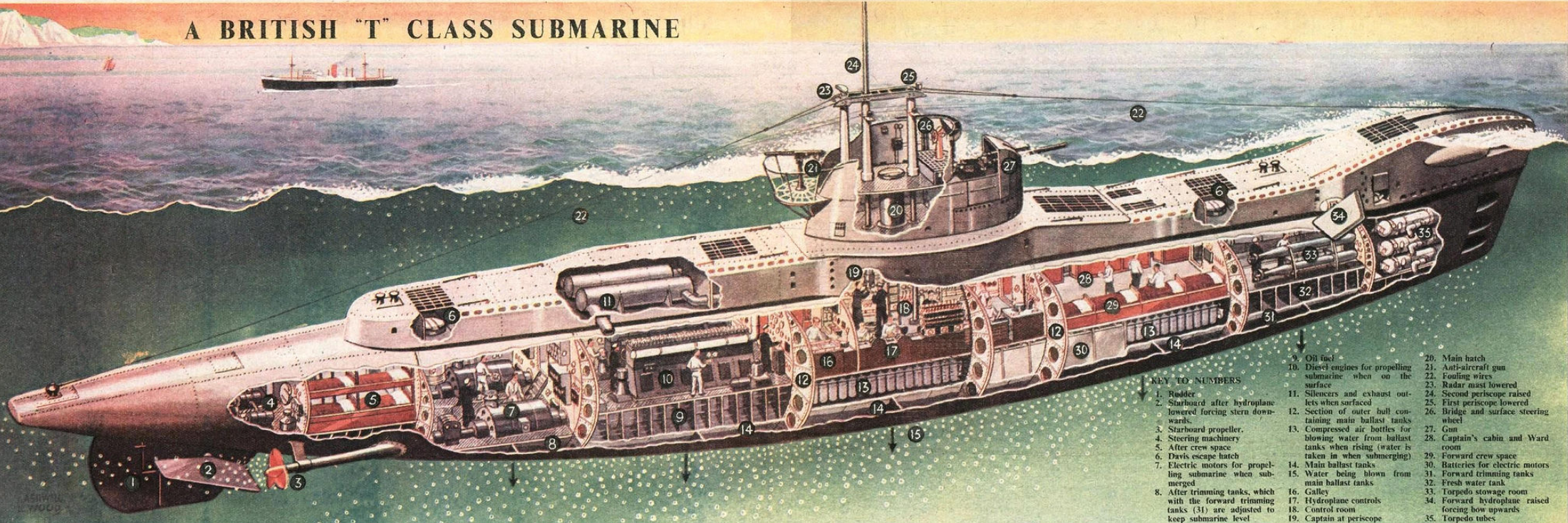
(1) Asdic dome. (2) Hydroplane. (3) Diesel generator. (4) Toilets. (5) Engineers' store. (6) Gas bottles (batteries beyond). (7) Mess decks. (8) Ward room. (9) One-man escape chamber. (10) Galley. (11) Ballast pump. (12) Trim pump. (13) Air compressor. (14) Gas bottles. (15) Steering position. (16) Hydroplane controls. (17) W/T office. (18) Oilskin locker. (19) Tank space. (20) Switch-board (port side). (21) Main starboard motor. (22) Control panels. (23) Remote-control panel. (24) Triple pump. (25) Lubricating oil cooler. (26) Combustion chamber. (27) Catalytic chamber. (28) Gas cooler. (29) Condenser. (30) Turbine. (31) Gearbox. (32) Reserve Mess deck (also steering and hydroplane gear). (33) Propeller guard. (34) Indicator buoy. (35) Escape hatch. (36) Air induction mast. (37) Periscope. (38) Whip aerial. (39) Retractable bollards. (40) Hawse pipe cover-plate.



As shown on the left, the *Explorer* has her tanks (orange) beneath her pressure hull (black) instead of at the sides, as on earlier vessels.



A BRITISH "T" CLASS SUBMARINE



KEY TO NUMBERS

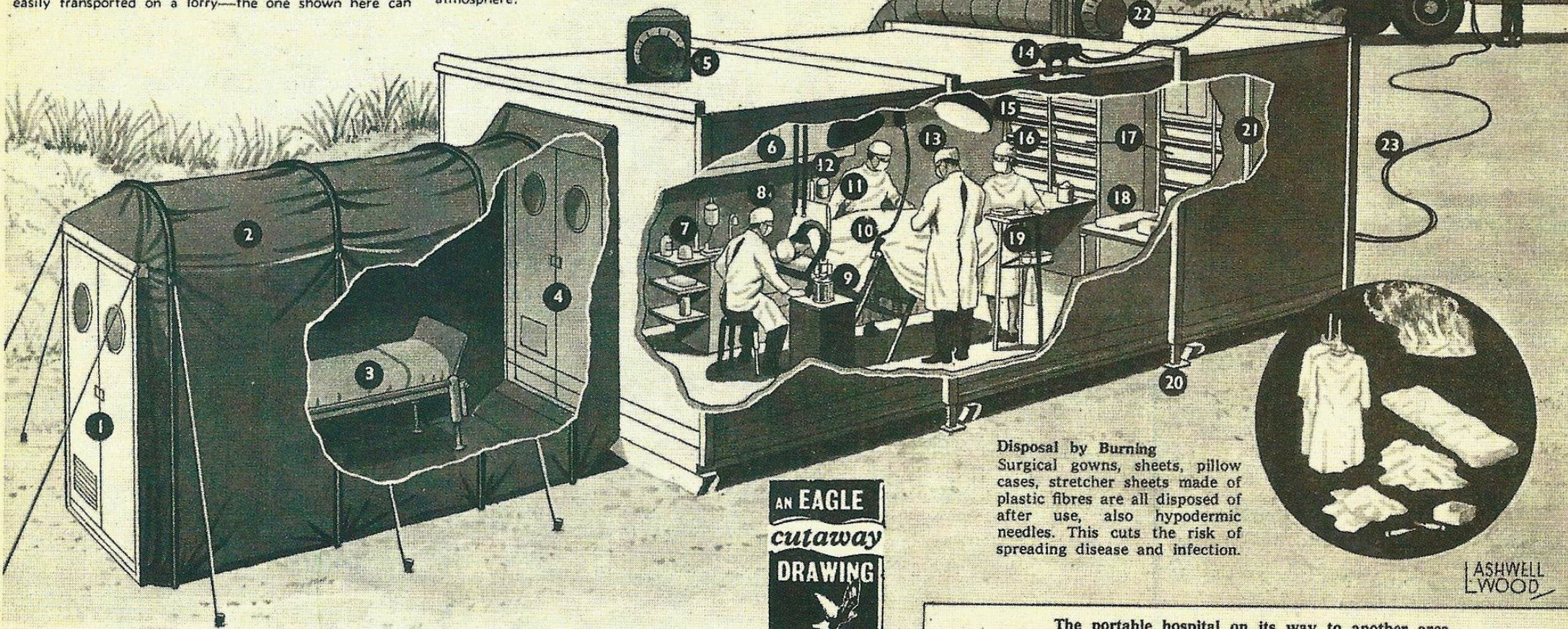
1. Rudder
2. Starboard after hydroplane lowered forcing stern downwards
3. Starboard propeller
4. Steering machinery
5. After crew space
6. Davis escape hatch
7. Electric motors for propelling submarine when submerged
8. After trimming tanks, which with the forward trimming tanks (31) are adjusted to keep submarine level
9. Oil fuel
10. Diesel engines for propelling submarine when on the surface
11. Silencers and exhaust outlets when surfaced
12. Section of outer hull containing main ballast tanks
13. Compressed air bottles for blowing water from ballast tanks when rising (water is taken in when submerging)
14. Main ballast tanks
15. Water being blown from main ballast tanks
16. Galley
17. Hydroplane controls
18. Control room
19. Captain at periscope
20. Main hatch
21. Anti-aircraft gun
22. Fouling wires
23. Radar mast lowered
24. Second periscope raised
25. First periscope lowered
26. Bridge and surface steering wheel
27. Gun
28. Captain's cabin and Ward room
29. Forward crew space
30. Batteries for electric motors
31. Forward trimming tanks
32. Fresh water tank
33. Torpedo stowage room
34. Forward hydroplane raised forcing bow upwards
35. Torpedo tubes

PORTABLE HOSPITAL

A complete operating room in an outside packing case—that is what this portable hospital really is. It is used by the United States Army in remote areas and by other medical units working in isolated places far from town or city hospitals. The portable hospital is made from a large packing case or shipping container with double skin insulation all round. An inflatable shelter that goes with it is used as an extra hospital ward.

The whole unit can be moved at any time and is easily transported on a lorry—the one shown here can

go over land or move on water like a boat. Inside, the portable hospital is equipped with everything needed for an emergency operation—anaesthetic and blood transfusion units, full medical supplies, special lighting and air-conditioning. Another important factor is the disposal after use of all surgical gowns, sheets, etc., by burning—thus reducing the risk of infection. Research is going on with a view to disposal of an entire operating room made from plastics—even including the inside atmosphere.



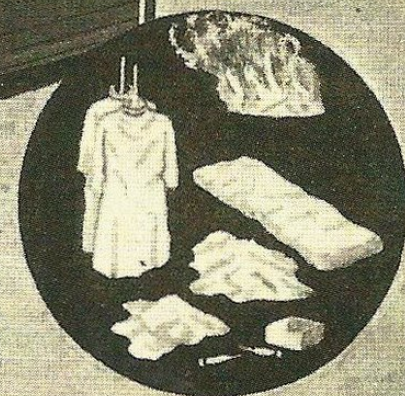
KEY TO NUMBERED PARTS

(1) Entrance door to hospital ward. (2) Inflatable and portable ward attached to the operating room. (3) Portable bed for an extra patient. (4) Entrance door to operating room. (5) Air-conditioning unit. (6) Medical supply cupboards. (7) Anaesthetic table. (8) Anaesthetist (an-es-thee-tist) — the person who applies the anaesthetic to the patient. (9) Anaesthetic appliances. An anaesthetic is a drug which causes deadening of the senses of the patient, enabling the

surgeon to operate without causing pain or distress. (10) Blood transfusion unit. (11) Assistant surgeon. (12) Blood count and drip. (13) Operating surgeon. (14) Electrical supply plug. (15) Special lighting. (16) Hospital Sister in charge of instruments. (17) Instrument trays and medical supplies. (18) Sterilizing trays. (19) Instrument table. (20) Legs for jacking up the portable case. (21) Insulated lining. (22) Air-conditioning unit. (23) Electrical supply cables. (24) Transporter lorry supplying electrical power.

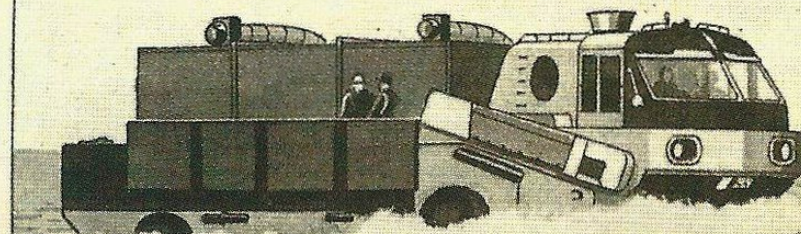
Disposal by Burning

Surgical gowns, sheets, pillow cases, stretcher sheets made of plastic fibres are all disposed of after use, also hypodermic needles. This cuts the risk of spreading disease and infection.



ASHWELL
WOOD

The portable hospital on its way to another area. This particular lorry can cross water as well as ground.



CAR IN THE SKY

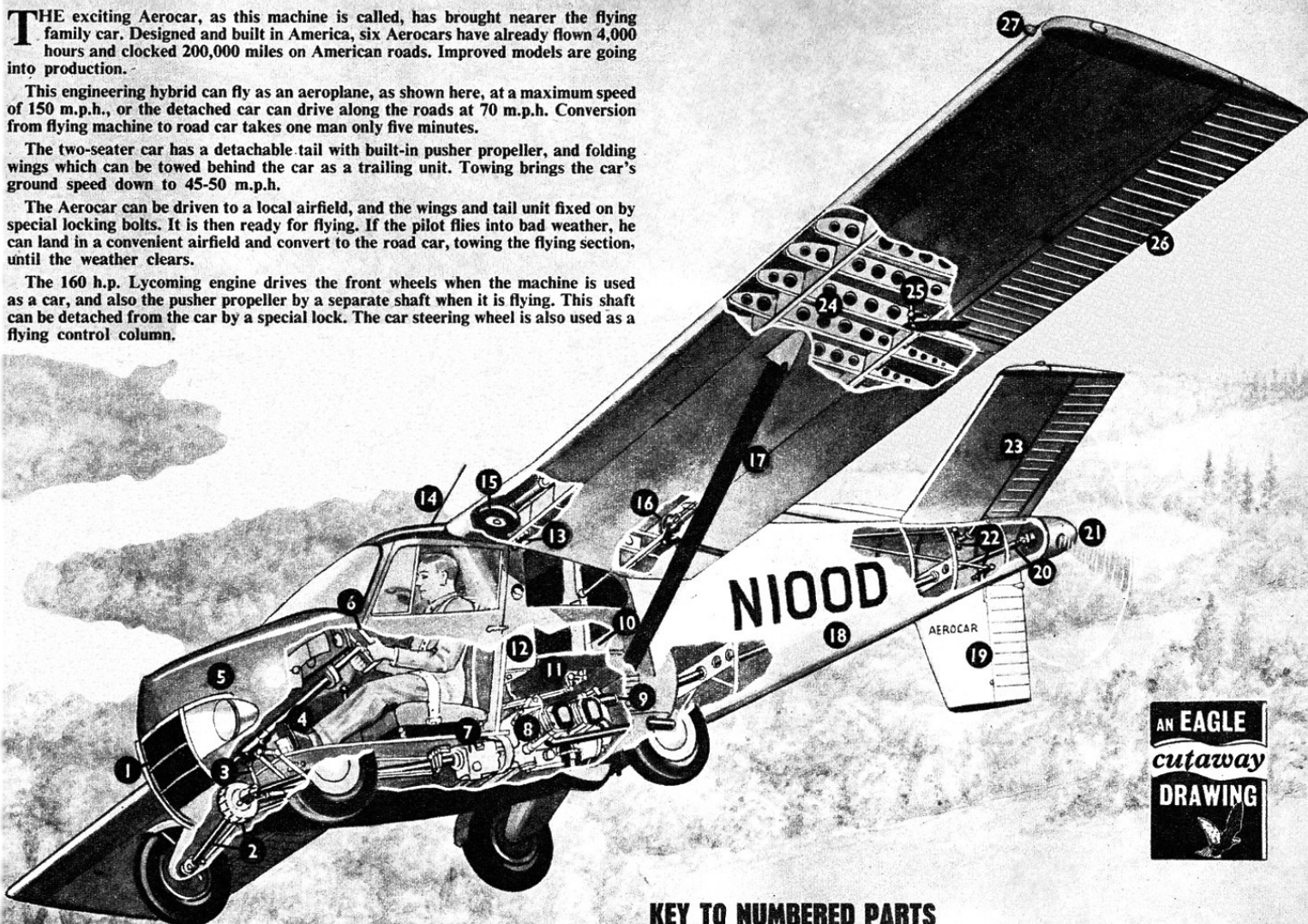
THE exciting Aerocar, as this machine is called, has brought nearer the flying family car. Designed and built in America, six Aerocars have already flown 4,000 hours and clocked 200,000 miles on American roads. Improved models are going into production.

This engineering hybrid can fly as an aeroplane, as shown here, at a maximum speed of 150 m.p.h., or the detached car can drive along the roads at 70 m.p.h. Conversion from flying machine to road car takes one man only five minutes.

The two-seater car has a detachable tail with built-in pusher propeller, and folding wings which can be towed behind the car as a trailing unit. Towing brings the car's ground speed down to 45-50 m.p.h.

The Aerocar can be driven to a local airfield, and the wings and tail unit fixed on by special locking bolts. It is then ready for flying. If the pilot flies into bad weather, he can land in a convenient airfield and convert to the road car, towing the flying section, until the weather clears.

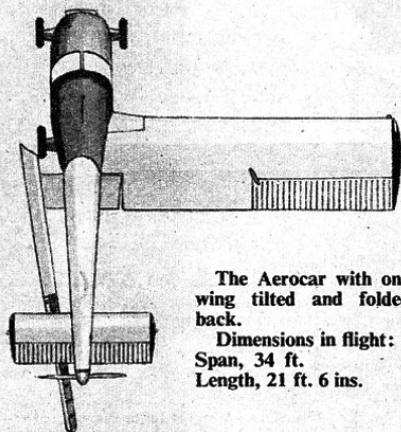
The 160 h.p. Lycoming engine drives the front wheels when the machine is used as a car, and also the pusher propeller by a separate shaft when it is flying. This shaft can be detached from the car by a special lock. The car steering wheel is also used as a flying control column.



KEY TO NUMBERED PARTS

(1) Air inlet to engine and air conditioning system. (2) Front wheel drive gear and shafts. (3) Front wheel steering and combined aileron and elevator flying controls. (4) Rudder foot pedals. There are also the usual road car controls of accelerator, clutch and brake. (5) Fibre-glass car body. (6) Car steering wheel and combined flying control column. (7) Three-speed road gearbox and fluid drive-shaft to front wheels. (8) Four-cylinder horizontally opposed 160 h.p. Lycoming engine. (9) Special clutch and drive to rear propeller shaft when flying. (10) Luggage boot. (11) Three-point flying controls - ailerons, elevators and rudder. (12) Petrol tank - 36 gallons. (13) Front-wing locking bolts. (14) Radio aerial. (15) Retractable trailer wheel when wings are folded back for road transport. (16) Rear wing tilting and folding lock with detachable aileron connections. (17) Wing strut (folds back with wing). (18) Fibre-glass covered fuselage attached to car body by locking bolts. (19) Fin and rudder. (20) Propeller drive shaft. (21) 6-ft. diameter pusher propeller. (22) Rudder and elevator controls. (23) V-angle tailplane and elevators. (24) All-metal wing construction. (25) Aileron controls. (26) Aileron. (27) Retractable towing arm when wings are folded back for road transport.

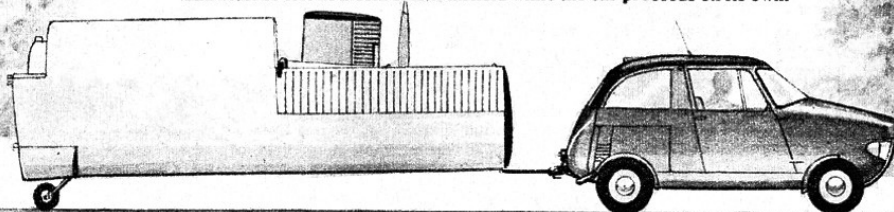
ASHWELL
WOOD



The Aerocar with one wing tilted and folded back.

Dimensions in flight: -
Span, 34 ft.
Length, 21 ft. 6 ins.

The Aerocar as a trailer on the road. The fuselage is detached from the car and towed tail-first with wings folded back. The ailerons are folded over to allow clearance for the tailplane, and the trailer wheel extended. The aircraft can be left at a convenient airfield while the car proceeds on its own.



A NEW road connection between Southern England and South Wales has long been needed, but one big obstacle was in the way – the River Severn.

Now this has been overcome by the magnificent new Severn Suspension Bridge expected to be opened this autumn. The new bridge crosses the River Severn just above the point where the River Wye joins it. The scheme, costing some £16 million, includes bridges over both rivers with a connecting viaduct.

The Severn Road Bridge, with a span of 3,240 ft., will be the second longest in Britain and the sixth longest in the world. The new Forth road bridge, with a span of 3,300 ft., is the longest in Britain and the fourth longest in the world.

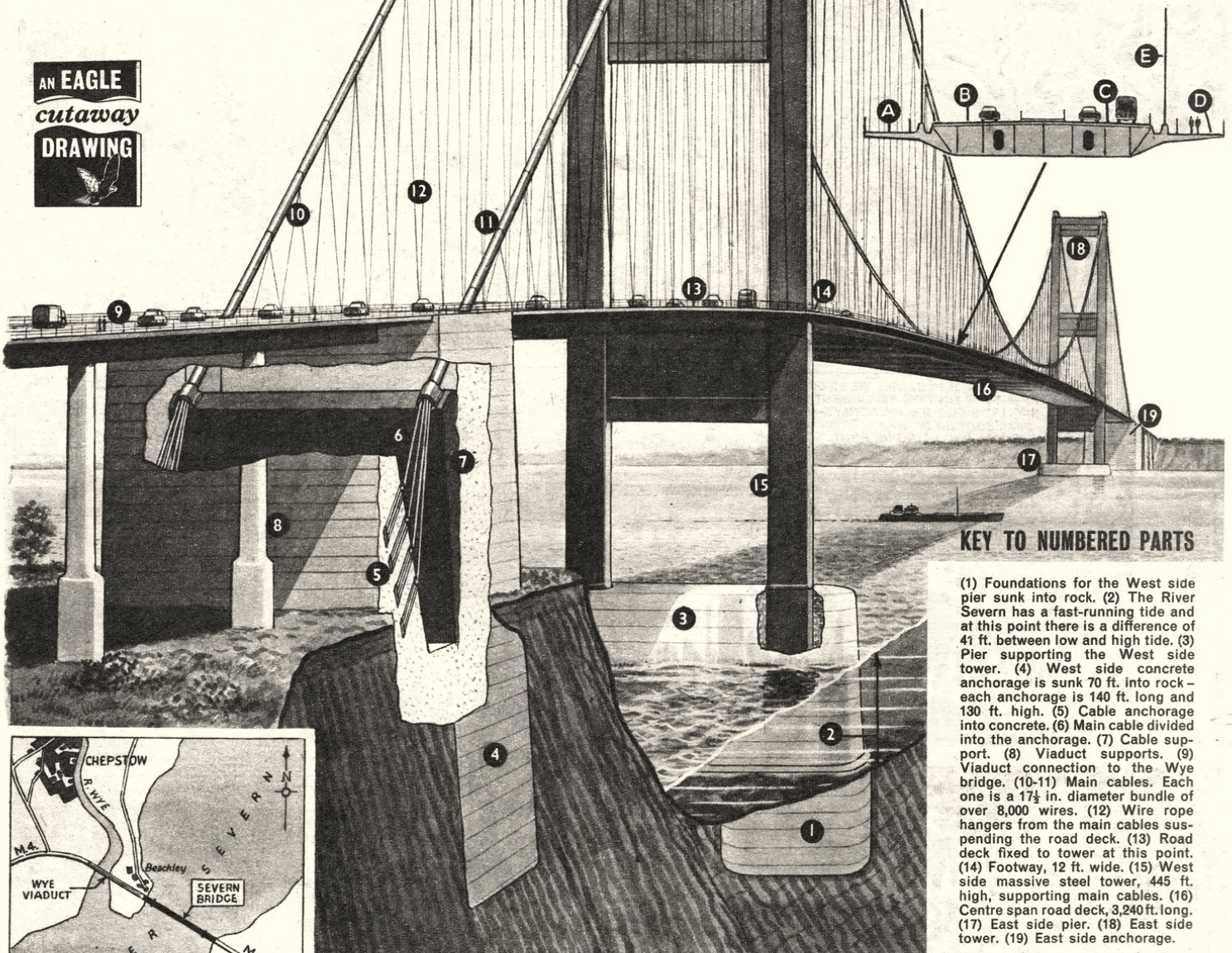
Principal dimensions of the Severn Bridge are shown below, but other amazing facts are: main towers, 2,450 tons of steelwork; cables, 4,400 tons of steel wire; suspended road deck, 11,200 tons of steelwork; concrete, 120,000 cubic yards.

**AN EAGLE
cutaway
DRAWING**

NEW WONDER BRIDGE

ACROSS THE RIVER SEVERN

Section of the suspended box steel road deck:
(A) 12 ft. cycle way. (B) 24 ft. roadway. (C) 24 ft. roadway. (D) 12 ft. footway. (E) Wire rope suspension hangers.

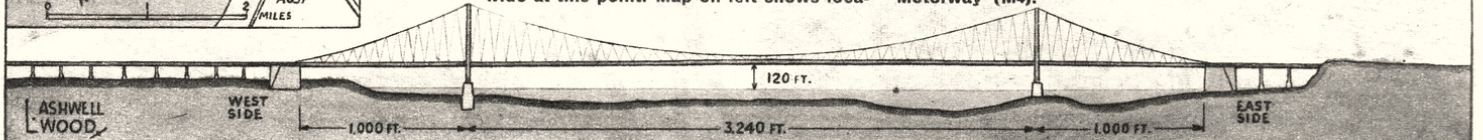


KEY TO NUMBERED PARTS

- (1) Foundations for the West side pier sunk into rock. (2) The River Severn has a fast-running tide and at this point there is a difference of 41 ft. between low and high tide. (3) Pier supporting the West side tower. (4) West side concrete anchorage is sunk 70 ft. into rock – each anchorage is 140 ft. long and 130 ft. high. (5) Cable anchorage into concrete. (6) Main cable divided into the anchorage. (7) Cable support. (8) Viaduct supports. (9) Viaduct connection to the Wye bridge. (10-11) Main cables. Each one is a 17½ in. diameter bundle of over 8,000 wires. (12) Wire rope hangers from the main cables suspending the road deck. (13) Road deck fixed to tower at this point. (14) Footway, 12 ft. wide. (15) West side massive steel tower, 445 ft. high, supporting main cables. (16) Centre span road deck, 3,240 ft. long. (17) East side pier. (18) East side tower. (19) East side anchorage.

Elevation of the Severn Suspension Bridge and principle dimensions. The river is a mile wide at this point. Map on left shows location and connection to the new Wye viaduct and new London-South Wales Motorway (M4).

tion and connection to the new Wye viaduct and new London-South Wales Motorway (M4).



THE GOLDEN GATE BRIDGE

The Golden Gate Strait is so-called because ships passing out of San Francisco Bay into the Pacific in the evening, sail into the rays of the setting sun!

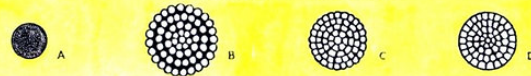
KEY TO PARTS OF THE MAIN DRAWING

(1) North Pier, founded on rock in 20 ft. of water at foot of cliff, (2) South Pier, 1,125 ft. off shore and virtually in open sea. (3) Centre Span, 4,200 ft. long – the world's longest single suspended span; the deck hangs 250 ft. above water and is 90 ft. wide. It accommodates 6 lanes of traffic and 2 footways. (4) Approach Spans. (5) Stiffening truss, 25 ft. deep. (6) Both towers are 746 ft. high. (7) Cables; 36 in. in diameter, 90 ft. apart. (8) Cable Saddles. (9) Hangers. (10) Section of horizontal bracing; outer casing removed, showing girders. (11) Section of Tower Leg showing cellular design. At the base, each leg is built up of 97 cells, 3 ft. 6 ins. square, made of steel plates $\frac{1}{2}$ inch thick. The towers are tapered by successively reducing the number of cells as the height increases, until at the top there are only 21 cells. (12) The South Pier was built inside a huge Fender, nicknamed 'The Bathtub' by the workmen. (13) The Fender is based on bedrock 100 ft. below water-level. (14) Base of Fender – concrete 65 ft. thick. (15) The Pier was built 'in the dry' inside, the water having been pumped out. When the work was completed, water was again allowed to enter inside the Fender, where it now helps to resist the force of wave action on the outer wall and so strengthens the foundations. (16) Fender Rim rises 15 ft. above water. (17) There are four 7 $\frac{1}{2}$ -knot tides, which sweep in and out of the Bay every 24 hours, and only four periods (of 20 minutes each) at the turn of each tide during which divers engaged on the underwater construction of the Fender could work! This is just one example of the many difficulties which presented themselves to the builders of this mighty bridge.

Before work could commence on this great bridge spanning the Golden Gate Strait, the United States War Department had to give its assent. They had to be satisfied that there was sufficient depth of water for the bridge to sink without causing any obstruction to shipping should it be wrecked at any time!

A glance at the map (extreme right), which shows the position of the bridge, makes this wise precaution all the more evident. San Francisco is one of the largest and most important American ports, whose wonderful bay provides excellent shelter to shipping.

THE STRUCTURE OF THE MAIN CABLES



The steel wires, of which the cables are composed, are no thicker than piano wires and they are laid straight, without any spiral lay as in ordinary ropes. The cables are made up of 61 strands; in each strand there are 451 wires. (A) The 61 strands are laid into one cable . . . (B) and powerfully compressed. (C) shows them partly compacted. When fully compacted . . . (D) the strands become hexagonal in shape. Altogether there are 27,511 wires in each cable, which is 36 $\frac{1}{2}$ inches in diameter.



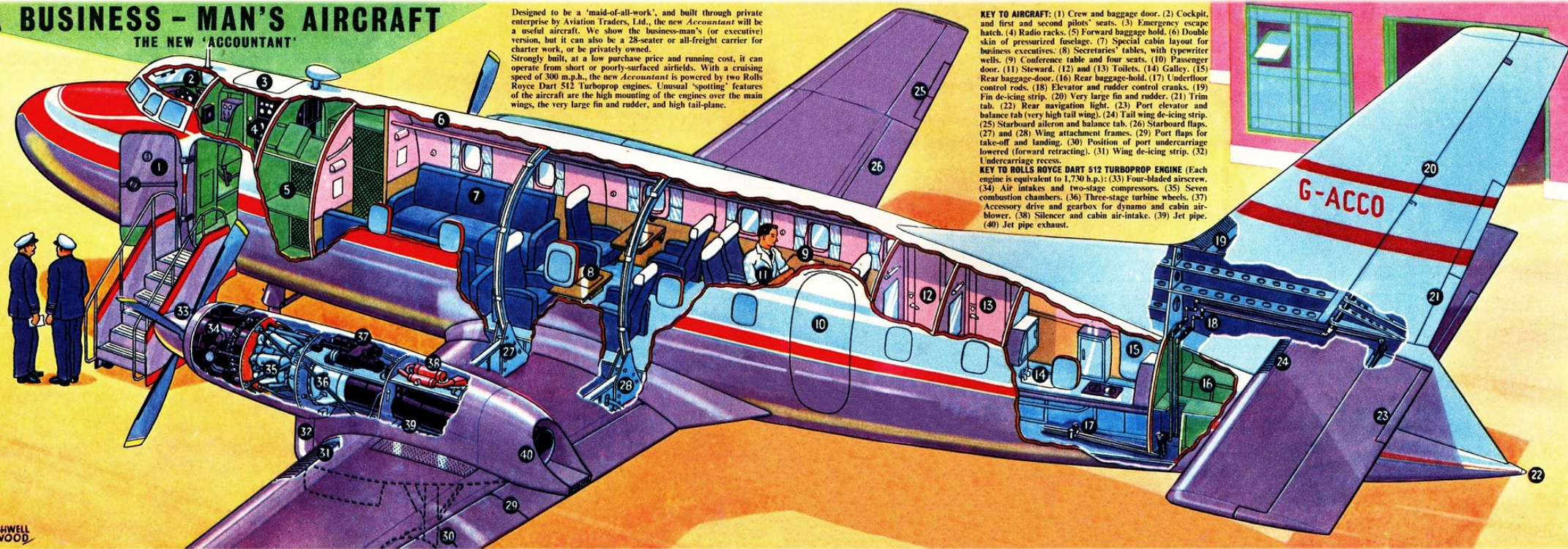
A BUSINESS - MAN'S AIRCRAFT

THE NEW 'ACCOUNTANT'

Designed to be a 'maid-of-all-work', and built through private enterprise by Aviation Traders, Ltd., the new *Accountant* will be a useful aircraft. We show the business-man's (or executive) version, but it can also be a 28-seater or all-freight carrier for charter work, or be privately owned. Strongly built, at a low purchase price and running cost, it can operate from short or poorly-surfaced airfields. With a cruising speed of 300 m.p.h., the new *Accountant* is powered by two Rolls Royce Dart 512 Turboprop engines. Unusual 'spotting' features of the aircraft are the high mounting of the engines over the main wings, the very large fin and rudder, and high tail-plane.

KEY TO AIRCRAFT: (1) Crew and baggage door. (2) Cockpit, and first and second pilots' seats. (3) Emergency escape hatch. (4) Radio racks. (5) Forward baggage hold. (6) Double skin of pressurized fuselage. (7) Special cabin layout for business executives: (8) Secretaries' tables, with typewriter wells. (9) Conference table and four seats. (10) Passenger door. (11) Steward. (12) and (13) Toilets. (14) Galley. (15) Rear baggage-door. (16) Rear baggage-hold. (17) Underfloor control rods. (18) Elevator and rudder control cranks. (19) Fin de-icing strip. (20) Very large fin and rudder. (21) Trim tab. (22) Rear navigation light. (23) Port elevator and balance tab (very high tail wing). (24) Tail wing de-icing strip. (25) Starboard aileron and balance tab. (26) Starboard flaps. (27) and (28) Wing attachment frames. (29) Port flaps for take-off and landing. (30) Position of port undercarriage lowered (forward retracting). (31) Wing de-icing strip. (32) Undercarriage recess.

KEY TO ROLLS ROYCE DART 512 TURBOPROP ENGINE (Each engine is equivalent to 1,730 h.p.): (33) Four-bladed airscrew. (34) Air intakes and two-stage compressors. (35) Seven combustion chambers. (36) Three-stage turbine wheels. (37) Accessory drive and gearbox for dynamo and cabin air-blower. (38) Silencer and cabin air-intake. (39) Jet pipe. (40) Jet pipe exhaust.



THE BEGINNINGS OF THE RAILWAY

THE FAMOUS ROCKET

From time to time we have featured modern locomotives on these centre pages, so here, after many requests, we show one of the earliest and most successful locomotives—George Stephenson's famous *Rocket*. It is pictured with George Stephenson and his son Robert on the footplate, running in the Rainhill Trials in October 1829. It won the prize of £500 offered by the Liverpool and Manchester Railway and proved the efficiency of the steam locomotive. In fact, the *Rocket* laid down the principles which apply to modern locomotive practice.

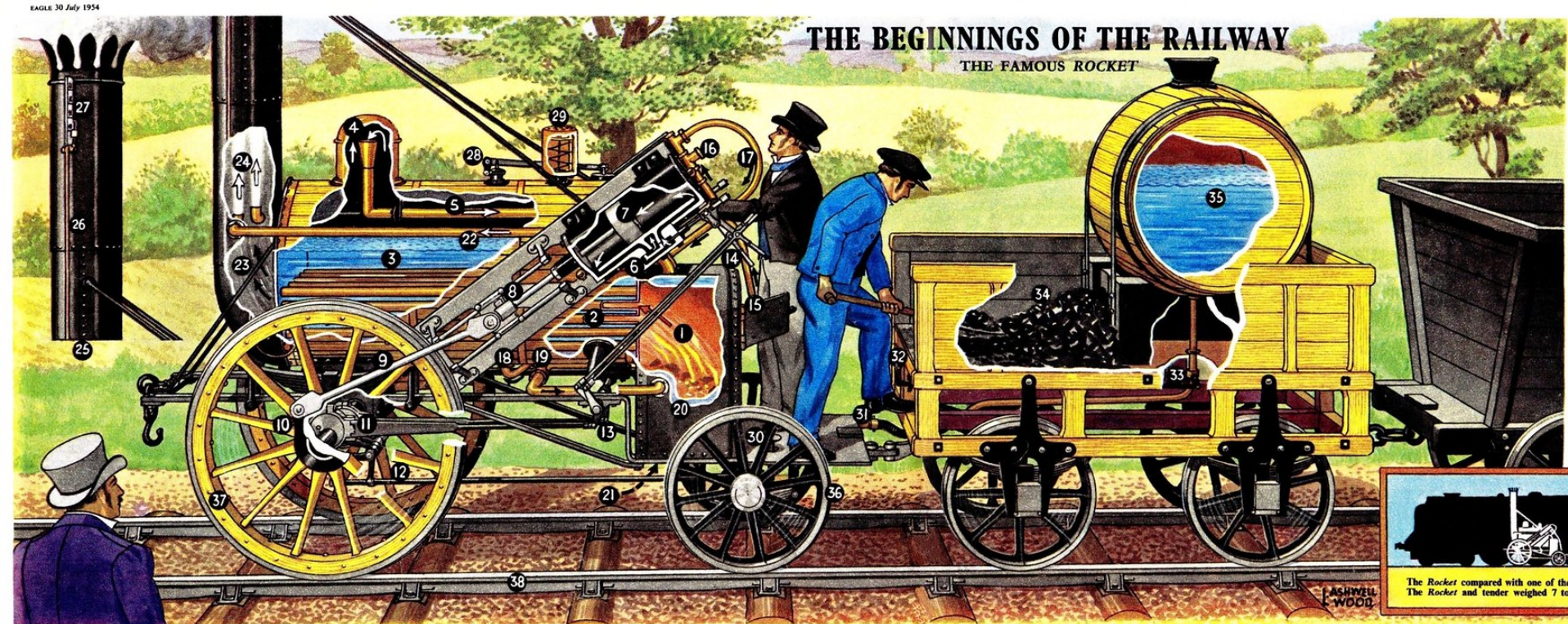
The *Rocket* was subsequently altered by lowering the angle of the cylinders and adding a complete smoke-box. The original is now in the Science Museum, South Kensington, London.

KEY TO HOW IT WORKED.

(1) Fire-box. (2) Fire-tubes surrounded by water (25 in all). (3) Water level. (4) Steam dome and collecting pipe. (5) Steam pipe to cylinders. (6) Slide valve admitting steam to each side of the piston alternately. (7) Piston on the downward stroke (8 ins. diameter; 17 ins. stroke). (8) Piston rod and crosshead. (9) Connecting rod. (10) Crank. (11) Eccentrics for driving the slide valve levers, one being set for forward running, the other for reverse. (12) Rod operating the collars for engaging the eccentrics on the axle. (13) Eccentric levers. (14) Slide valve levers. These could be moved by hand when reversing. (15) Water supply from tender. (16) Water injector pump to boiler. The boiler was of iron, lagged with wood. (17) Water supply to boiler. (18) Water jacket surrounding fire-box. (19) Water supply to fire-box jacket. (20) Water jacket surrounding fire-box. (21) Air draught to fire-grate. (22) Exhaust steam pipe. (23) Smoke-box. (24) Exhaust steam blast. (25) Extension of chimney to same scale. (26) Mercury tube. (27) Mercury operated boiler pressure gauge. Boiler pressure was 50 lbs. per square inch. (28) Weight-loaded safety valve. (29) Spring-loaded safety-valve. (30) Foot pedal for engaging eccentrics. (31) Water connection. (32) Water control lever. (33) Water cock. (34) Coal supply. (35) Water barrel (300 gallons). (36) Trailing wheel. (37) Driving wheel; 4 ft. 8½ ins. diameter (wood, bound with iron). (38) Fish-belly rails.



The *Rocket* compared with one of the largest British Railways locomotives; same scale. The *Rocket* and tender weighed 7 tons 9 cwt; this modern locomotive, 161 tons 12 cwt.



ASHWELL
WOOD

A PEEP BEHIND THE MAN IN THE MOON

The London Palladium has a reputation as the Ace Variety Theatre of the world, and also for its production of wonderful pantomimes.

In this special Christmas drawing, we take you back-stage of this year's pantomime - 'The Man in the Moon', - and show you the wonderful on- and off-stage lighting during a performance, the scenic layout, and the operating machinery below stage for the

three sections of the famous revolving stage. All lighting is controlled from the control console in the circle - where the operator can see he is getting the required effects.

At the rear of the stage, there are 20 dressing rooms. It is not generally known, but there are two artesian wells beneath the theatre from which water is obtained from a depth of 420 feet, independent of the mains supply.

AN EAGLE
cutaway
DRAWING

The lighting control console at the right-hand side of the circle.

Here all lighting, dimming, fading, etc., is under direct control - there are over 500 combinations. (A) Selector tabs. (B) Pre-selector stops. (C) Operating keys. (D) Black keys operate colour changes. (E) Current indication meters. (F) Inter-com. to Chief Electrician and Stage Director.

KEY TO THEATRE & LIGHTING SYSTEM

(1) Access from dressing rooms and stage door. (2) Portable wing spotlights. (3) Back of wing scenery. (4) Trap door. (5) Rising trap platform in basement. (6) Special scenery-effects trolley (moves across stage). (7) Curtain controls. (8) Stage Director's desk. (9) Sound-effects tapes. Anything from an elephant's bellow to a jet airliner can be reproduced! (10) Hydraulic cylinder for main curtain. (11) Main curtain raised. (Curtains are known as 'house tabs'). (12) 'Pageant' lights. (13) Tracer spotlights for following actors across stage. (14) Rising microphone. (The floor of the orchestra-pit can be raised to stage level). (15) Front curtain lowered for front stage act (shown cutaway). (16) Inner or false proscenium opening. (17) No. 1 Batten, divided into sections each with its own colour-change lights. (18) No. 1 Acting area flood-lights. (19) No. 2 Acting area flood-lights. (20) Scenery and curtain 'back drops' hanging from 52 feet up in the stage roof. (21) 2,000 watt automatic colour-change spotlights. (22) Lower loudspeaker. (23) Outer proscenium

opening. (24) No. 2 Batten. (25) No. 3 Acting area flood-lights and batten. (26) 'Pageant' and tracer spotlights. (27) Special effects trolley. (28) Wing scenery 'flat'. (29) Special effects trolley - pivots out on to stage. (30) 1,000 watt portable wing floodlights. (31) Counter-balances for 'back drops'. (32) No. 4 Acting area flood-lights and batten. (33) 'Backcloth' top lighting batten. (34) Final 'backcloth'. This marks the back of the stage - 41 feet from the front. (35) Access to dressing rooms. (36) 'Back drop' being lowered. **Key to revolving stage:** (37) 12 ft.-diameter centre of stage can also be used as a lift. (38) 3 ft.-wide inner revolving stage. (39) 7 ft.-wide outer revolving stage. The inner and outer stages can be revolved in different directions independently, or the whole revolving stage locked as one. (40) Scenery set being prepared while front stage act is on. It is then revolved to the front and curtain raised ready for act. (41) Lift counter-balance. (42) Lift machinery. (43) Operator in control of lift and revolving stage. (44) Outer stage girders. (45) Outer stage electric motor and operating gear. (46) Pulley gear and steel ropes for revolving outer stage.

LASHWELL
WOOD

HMS SALISBURY

This ship is the first of four of a new class known as Aircraft Direction (A/D) Frigates, which are primarily designed for the direction and detection of aircraft, either carrier borne or shore based. This calls for exceptionally elaborate radio and electronic equipment, but, armed with a squid, two Bofors guns and two 4.5 in. guns, she may also be used as a destroyer.

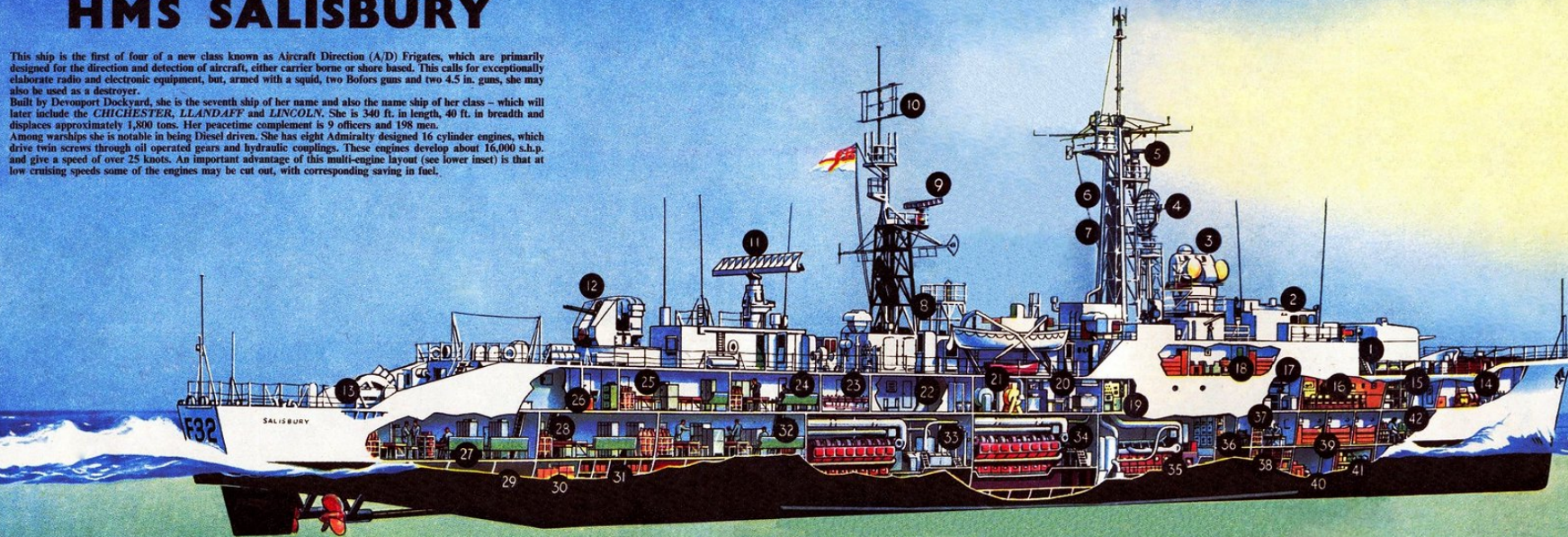
Built by Devonport Dockyard, she is the seventh ship of her name and also the name ship of her class - which will later include the *CHICHESTER*, *LLANDAFF* and *LINCOLN*. She is 340 ft. in length, 40 ft. in breadth and displaces approximately 1,800 tons. Her peacetime complement is 9 officers and 198 men.

Among warships she is notable in being Diesel driven. She has eight Admiralty designed 16 cylinder engines, which drive twin screws through oil operated gears and hydraulic couplings. These engines develop about 16,000 s.h.p. and give a speed of over 25 knots. An important advantage of this multi-engine layout (see lower inset) is that at low cruising speeds some of the engines may be cut out, with corresponding saving in fuel.



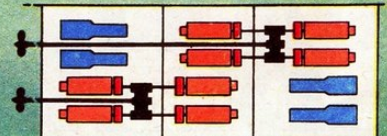
KEY TO NUMBERED PARTS:

(1) 4.5 in. twin mounting. (2) Bridge. (3) Gunnery director. (4) Aircraft detection aerial. (5) Navigational radar. (6) Forward main engine exhaust. (7) Forward generator exhaust. (8) Emergency conning position. (9) Surface warning aerial. (10) Aircraft direction aerial. (11) Aircraft direction aerial. (12) Twin 40 m.m. Bofors. (13) Squid. (14) Auxiliary generator. (15) Provision issue room. (16) Wardroom. (17) Wardroom galley. (18) Captain's suite. (19) Engine control room. (20) Galley. (21) Laundry. (22) Fore and aft passage. (23) Petty Officers' washplace. (24) Petty Officers' mess. (25) Mess for Sick Bay Attendants, etc. (26) Office. (27) Seamen's mess. (28) Stokers' mess. (29) Fresh water tank. (30) Store. (31) Naval store. (32) Seamen's mess. (33) No. 3 engine room. (34) No. 2 engine room. (35) Auxiliary machinery. (36) Engineers' store and workshop. (37) Officers' Stewards' mess. (38) Victualling store. (39) Officers' cabins. (40) Refrigerating machinery. (41) Cold store. (42) Seamen's mess.



LAURENCE DUNN

Each of the twin screws is driven by 4 Diesel engines (orange) through gearbox (black) and fluid couplings (red). Auxiliary generators are shown in blue.



SHIPS OF THE ROYAL NAVY

A FIRST-CLASS DESTROYER

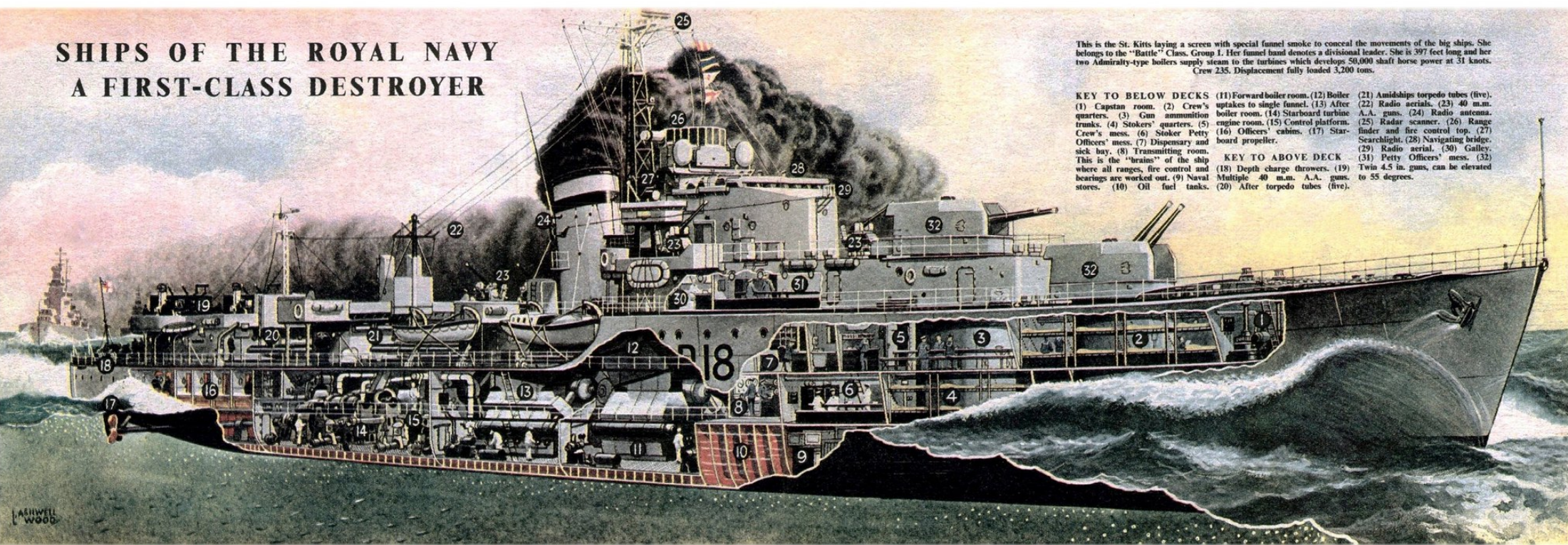
This is the St. Kitts laying a screen with special funnel smoke to conceal the movements of the big ships. She belongs to the "Battle" Class, Group I. Her funnel band denotes a divisional leader. She is 397 feet long and her two Admiralty-type boilers supply steam to the turbines which develop 50,000 shaft horse power at 31 knots. Crew 235. Displacement fully loaded 3,200 tons.

KEY TO BELOW DECKS

(1) Capstan room. (2) Crew's quarters. (3) Gun ammunition trunks. (4) Stokers' quarters. (5) Crew's mess. (6) Dispensary and sick bay. (8) Transmitting room. This is the "brains" of the ship where all ranges, fire control and bearings are worked out. (9) Naval stores. (10) Oil fuel tanks. (11) Forward boiler room. (12) Boiler uptakes to single funnel. (13) After boiler room. (14) Starboard turbine engine room. (15) Control platform. (16) Officers' cabins. (17) Starboard propeller. (18) Depth charge throwers. (19) Multiple 40 m.m. A.A. guns. (20) After torpedo tubes (five).

KEY TO ABOVE DECK

(21) Amidships torpedo tubes (five). (22) Radio aerials. (23) 40 m.m. A.A. guns. (24) Radio antenna. (25) Radar scanner. (26) Range finder and fire control top. (27) Searchlight. (28) Navigating bridge. (29) Radio aerial. (30) Galley. (31) Petty Officers' mess. (32) Twin 4.5 in. guns, can be elevated to 55 degrees.



THE M.V. BARDIC FERRY

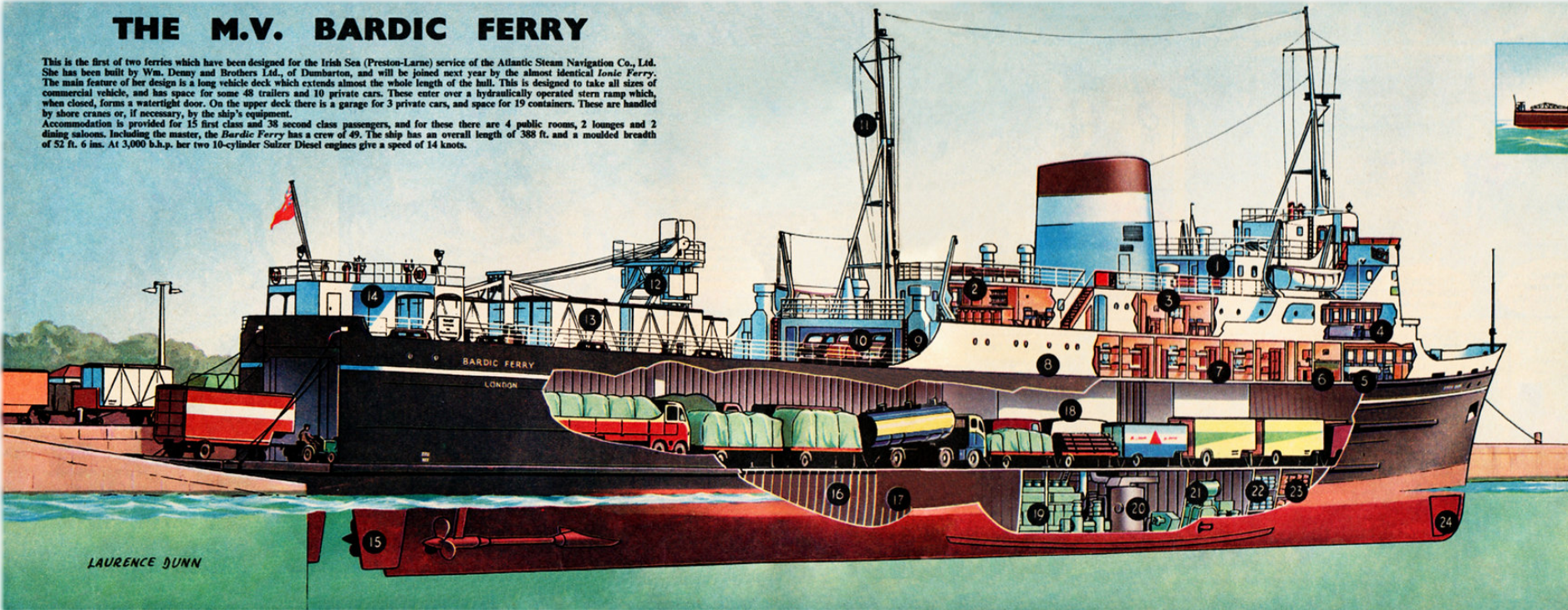
This is the first of two ferries which have been designed for the Irish Sea (Preston-Larne) service of the Atlantic Steam Navigation Co., Ltd. She has been built by Wm. Denny and Brothers Ltd., of Dumbarton, and will be joined next year by the almost identical *Ionic Ferry*. The main feature of her design is a long vehicle deck which extends almost the whole length of the hull. This is designed to take all sizes of commercial vehicle, and has space for some 48 trailers and 10 private cars. These enter over a hydraulically operated stern ramp which, when closed, forms a watertight door. On the upper deck there is a garage for 3 private cars, and space for 19 containers. These are handled by shore cranes or, if necessary, by the ship's equipment. Accommodation is provided for 15 first class and 38 second class passengers, and for these there are 4 public rooms, 2 lounges and 2 dining saloons. Including the master, the *Bardic Ferry* has a crew of 49. The ship has an overall length of 388 ft. and a moulded breadth of 52 ft. 6 ins. At 3,000 b.h.p. her two 10-cylinder Sulzer Diesel engines give a speed of 14 knots.



KEY TO NUMBERED PARTS

1. Deck shelter.
2. 2nd Class lounge.
3. 2 berth passenger cabin (left), Officers' lounge (right).
4. 1st Class lounge.
5. 2nd Class dining saloon (1st Class on port side).
6. Steward's cabin right (office on left).
7. 2nd Class cabins (1st Class on port side).
8. Crew's cabins.
9. Ventilators for deck below.
10. Garage for 3 private cars.
11. Extra light on each mast for use when going astern.
12. 20-ton electric crane.
13. Containers carried on upper deck only.
14. Docking bridge.
15. Twin spade-type rudders.
16. Dry compartment.
17. Dry compartment.
18. Engine room uptake.
19. Starboard main engine (Sulzer 10-cylinder Diesel).
20. Boiler.
21. Stabilizer compartment (stabilizer shown housed).
22. Linen store.
23. Flour store.
24. Bow rudder (used when going astern).

LAURENCE DUNN



THE SPACE-RACE GUINEA-PIG

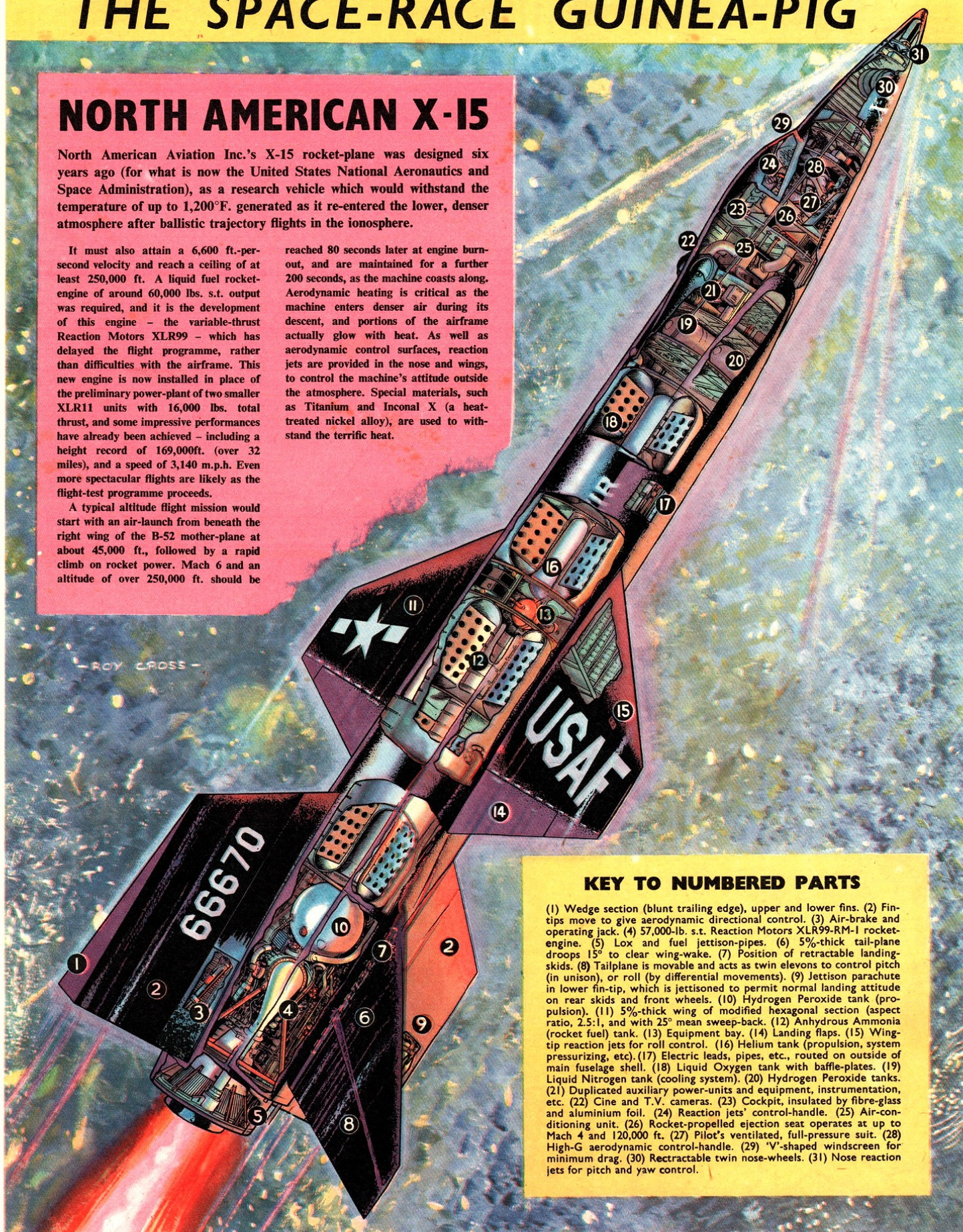
NORTH AMERICAN X-15

North American Aviation Inc.'s X-15 rocket-plane was designed six years ago (for what is now the United States National Aeronautics and Space Administration), as a research vehicle which would withstand the temperature of up to 1,200°F. generated as it re-entered the lower, denser atmosphere after ballistic trajectory flights in the ionosphere.

It must also attain a 6,600 ft.-per-second velocity and reach a ceiling of at least 250,000 ft. A liquid fuel rocket-engine of around 60,000 lbs. s.t. output was required, and it is the development of this engine - the variable-thrust Reaction Motors XLR99 - which has delayed the flight programme, rather than difficulties with the airframe. This new engine is now installed in place of the preliminary power-plant of two smaller XLR11 units with 16,000 lbs. total thrust, and some impressive performances have already been achieved - including a height record of 169,000ft. (over 32 miles), and a speed of 3,140 m.p.h. Even more spectacular flights are likely as the flight-test programme proceeds.

A typical altitude flight mission would start with an air-launch from beneath the right wing of the B-52 mother-plane at about 45,000 ft., followed by a rapid climb on rocket power. Mach 6 and an altitude of over 250,000 ft. should be

reached 80 seconds later at engine burn-out, and are maintained for a further 200 seconds, as the machine coasts along. Aerodynamic heating is critical as the machine enters denser air during its descent, and portions of the airframe actually glow with heat. As well as aerodynamic control surfaces, reaction jets are provided in the nose and wings, to control the machine's attitude outside the atmosphere. Special materials, such as Titanium and Inconel X (a heat-treated nickel alloy), are used to withstand the terrific heat.



KEY TO NUMBERED PARTS

(1) Wedge section (blunt trailing edge), upper and lower fins. (2) Fin-tips move to give aerodynamic directional control. (3) Air-brake and operating jack. (4) 57,000-lb. s.t. Reaction Motors XLR99-RM-1 rocket-engine. (5) Lox and fuel jettison-pipes. (6) 5%-thick tail-plane droops 15° to clear wing-wake. (7) Position of retractable landing-skids. (8) Tailplane is movable and acts as twin elevons to control pitch (in unison), or roll (by differential movements). (9) Jettison parachute in lower fin-tip, which is jettisoned to permit normal landing attitude on rear skids and front wheels. (10) Hydrogen Peroxide tank (propulsion). (11) 5%-thick wing of modified hexagonal section (aspect ratio, 2.5:1, and with 25° mean sweep-back. (12) Anhydrous Ammonia (rocket fuel) tank. (13) Equipment bay. (14) Landing flaps. (15) Wing-tip reaction jets for roll control. (16) Helium tank (propulsion, system pressurizing, etc.). (17) Electric leads, pipes, etc., routed on outside of main fuselage shell. (18) Liquid Oxygen tank with baffle-plates. (19) Liquid Nitrogen tank (cooling system). (20) Hydrogen Peroxide tanks. (21) Duplicated auxiliary power-units and equipment, instrumentation, etc. (22) Cine and T.V. cameras. (23) Cockpit, insulated by fibre-glass and aluminium foil. (24) Reaction jets' control-handle. (25) Air-conditioning unit. (26) Rocket-propelled ejection seat operates at up to Mach 4 and 120,000 ft. (27) Pilot's ventilated, full-pressure suit. (28) High-G aerodynamic control-handle. (29) 'V'-shaped windscreen for minimum drag. (30) Retractable twin nose-wheels. (31) Nose reaction jets for pitch and yaw control.

Commando Helicopter

The Westland Wessex Mk. 1 is now in service with the Royal Navy, both as an anti-submarine and assault-transport helicopter. The assault version is operated by the Royal Navy from aircraft carriers on behalf of the Royal Marine Commandos.

Commandos must be on hand in order to cope with trouble spots which may occur in any of the remote areas throughout the world. The Wessex is capable of operating over inaccessible jungle or desert.

As a transport helicopter it can carry 15 troops or 4,000 pounds of

equipment. The Westland Wessex Mk. 1 is powered by a 1,450 h.p. Napier Gazelle gas-turbine engine, giving a maximum forward speed of 125 knots or a cruising speed of 115 knots. The vertical rate of climb is 600 ft. per minute. Loaded weight of the helicopter is 12,600 pounds.

The engine, placed at an angle of 35 degrees, drives the main rotor head through a reduction gearbox. This gearbox also drives the tail rotor shaft.



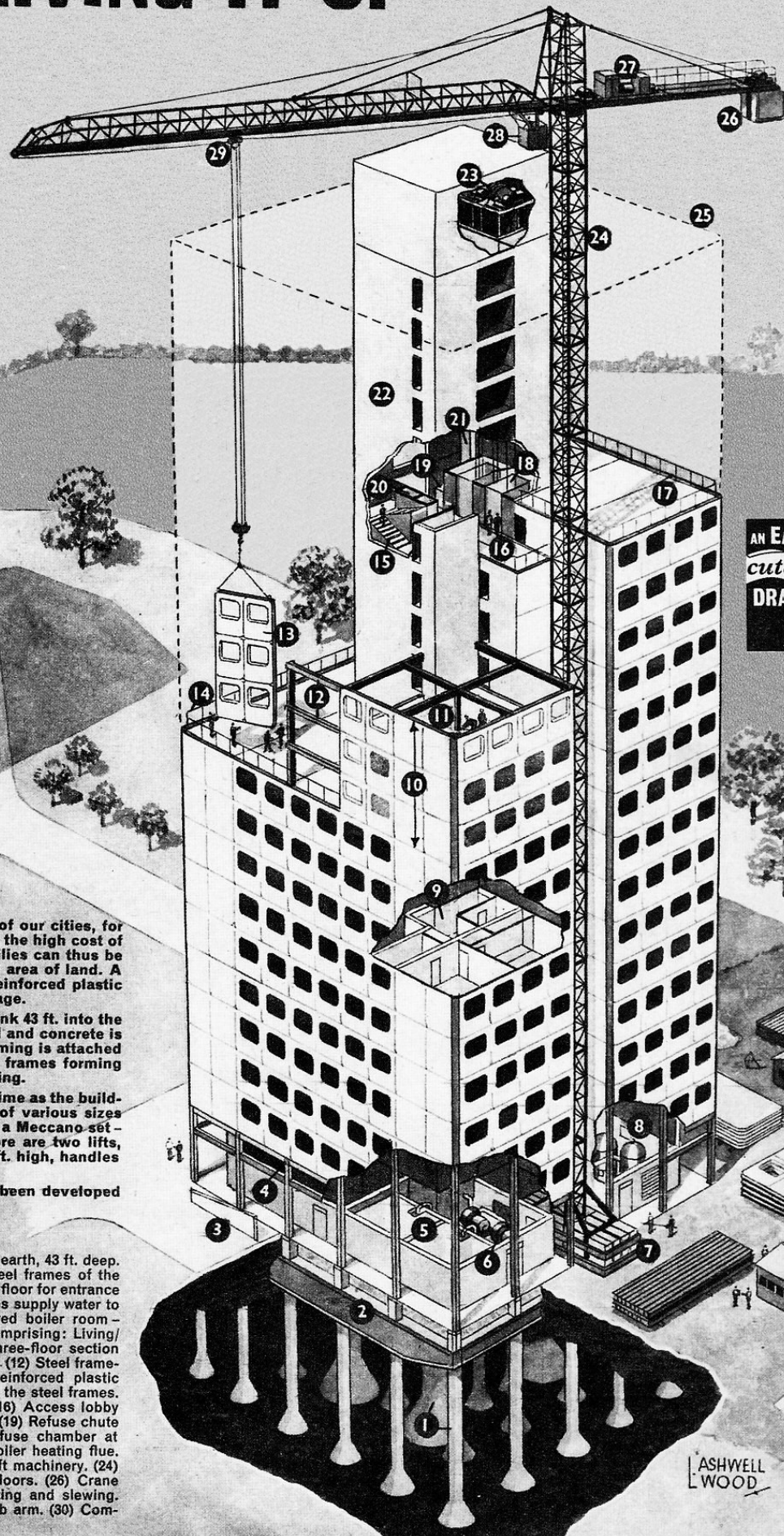
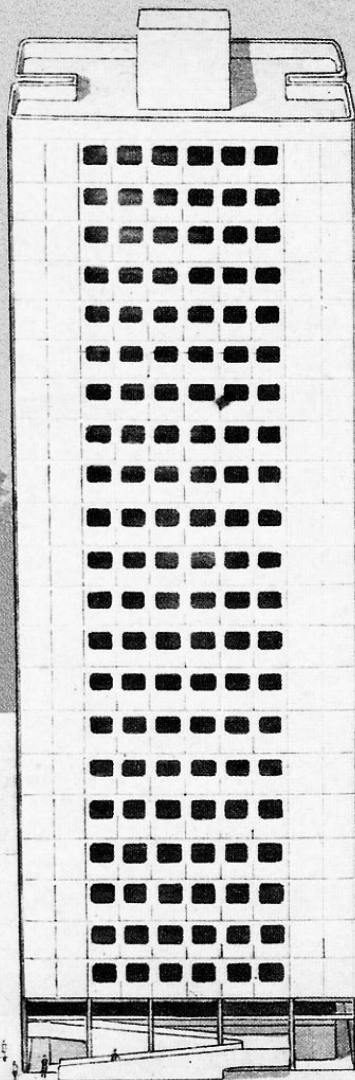
KEY TO NUMBERED PARTS

(1) Engine air intake grille. (2) D.C. generator. (3) Engine air inlets. (4) Retractable landing light. (5) Napier Gazelle engine. (6) Engine cooling air inlet. (7) Fire-proof shielding. (8) Exhaust ducts. (9) Batteries. (10) Radio equipment. (11) Tail rotor control pedals. These control the rotor head for forward,

backward or sideways flight. (12) Cyclic pitch lever. (13) Collective pitch lever. This controls the pitch of the rotor blades for vertical flight. (14) Drive shaft to rotor gearbox. (15) Main reduction gearbox. (16) Pitch control spider. (17) Rotor head. (18) Main rotor blades. (19) Rotor-driven generator. (20) Tail rotor drive shaft. (21) Rotor brake and drive to oil cooler. (22) Lubricating oil cooler. (23) Air intake to oil cooler. (24) Cabin air heating duct. (25) Cabin for 15 Commandos. (26) Steps to pilot's cockpit. (27) Main under-

carriage strut, fitted with oil dampers. (28) Fuel tanks under cabin floor - 300 gallons capacity. (29) Shackle for an alternative load of 4,000 pounds. (30) Fuel tank fillers. (31) Cabin air heater. (32) Radio aerial. (33) Tail rotor drive shaft. (34) Castor type tail wheel. (35) Tail folding hinge. (36) Intermediate gearbox. (37) Stabilizing fin. (38) Tail rotor drive shaft. (39) Tail rotor gearbox. (40) Tail rotor pitch control. The tail rotor is used for directional turning. (41) Anti-collision light.

'LIVING-IT-UP'



AN EAGLE
cutaway
DRAWING

Higher and higher goes the ever-changing face of our cities, for today, with the increasing demand for housing and the high cost of land, the tendency is to build upwards. Many families can thus be accommodated in a block of flats built on a small area of land. A unique method of construction using glass-fibre reinforced plastic panels for the outside cladding is shown on this page.

On the massive foundations of concrete piles, sunk 43 ft. into the earth, and huge steel beams, a central core of steel and concrete is built up to the full height of the building. Steel framing is attached and built out from the central core all round, the frames forming support for the floors and the outside plastic cladding.

Construction goes on in units of three floors at a time as the building rises eventually to 21 floors. There are 5 flats of various sizes to each floor. The construction could be likened to a Meccano set - being built up step by step. Inside the central core are two lifts, stairs and all services. A modern tower crane, 230 ft. high, handles all the steel work and outside plastic cladding.

This new system of block flat construction has been developed by F. G. Minter, Ltd., the building contractors.

KEY TO NUMBERED PARTS

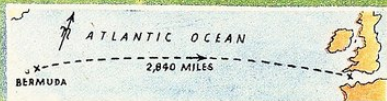
(1) Concrete foundation piles sunk by bore holes in the earth, 43 ft. deep.
(2) Steel beams forming a support platform for the steel frames of the building.
(3) Entrance ramp being built up.
(4) Mezzanine floor for entrance to lifts and stairs.
(5) Fresh-water tanks.
(6) Water pumps supply water to all flats.
(7) Ballast blocks for tower crane.
(8) Oil-fired boiler room - supplies heating to all flats.
(9) Typical corner flat, comprising: Living/Dining room, Bedroom, Kitchen and Bathroom.
(10) Three-floor section in place.
(11) Pre-cast concrete floor sections in place.
(12) Steel framework built up.
(13) Three-floor section of fibre-glass reinforced plastic cladding being placed in position. This will be bolted to the steel frames.
(14) Temporary safety rail.
(15) Stairs in central core.
(16) Access lobby for each floor.
(17) Temporary safety rail.
(18) Two lifts.
(19) Refuse chute - all refuse from each floor goes down to a large refuse chamber at ground level.
(20) Electrical and plumbing ducts.
(21) Boiler heating flue.
(22) Central core of steel and concrete built up.
(23) Lift machinery.
(24) Tower crane, 230 ft. high.
(25) Eventual height of 21 floors.
(26) Crane counter-balance weights.
(27) Electric motors for hoisting and slewing.
(28) Control cabin.
(29) Travelling hoisting pulleys on jib arm.
(30) Completed block of flats.

ASHWELL
WOOD

EAGLE 18 June 1954



CROSSING THE ATLANTIC UNDER WATER



The course of the *Andrew*, which dived off Bermuda and surfaced in the English Channel.

For the first time, a British submarine, the *Andrew* of 'A' class, has crossed the Atlantic under water all the way. This was only made possible by the use of the 'snort' apparatus, which provides air for breathing and also enables the submarine to run its Diesel engines while submerged.

This gives a greater under water speed than the normal use of electric motors, and also keeps the batteries charged. Here we show only the principle of the 'snort'. The *Andrew* used an improved secret one.

KEY TO SIMPLIFIED WORKING OF THE 'SNORT'

- (1) Fresh air intake and flap valve.
- (2) Diesel engine exhaust outlet and flap valves. Should the 'snort' get submerged by a wave, these valves automatically close.
- (3) Air and exhaust pipes in streamlined casing. (Air piping shown in yellow, exhaust in pink.)
- (4) Main control valve and pivot bearing to allow the 'snort' to lie horizontally on the deck.
- (5) Air control valve.
- (6) Pump which draws the fresh air in, and can also be reversed to blow stale air out.
- (7) Air pipe to compartments.
- (8) Air inlets to Diesel engines.
- (9) Diesel engine exhaust and control valves.
- (10) Exhaust expansion chamber from both engines.
- (11) Air compressor for charging the compressed air bottles, No. 35.

- (12) Main water ballast tanks.
- (13) 2,150 h.p. port Diesel engine. Both engines, running submerged, give the submarine a speed of about 14 knots as opposed to 8 knots when using the electric motors.
- (14) Clutch for disconnecting electric motors.
- (15) Port electric motor (not in use).
- (16) Port propeller.
- (17) After port hydroplane. Hydroplanes are used for diving and surfacing.
- (18) Hydroplane guard.
- (19) Balanced rudder.
- (20) Stern torpedo tubes.
- (21) After torpedo room.
- (22) Torpedo loading hatch.
- (23) Crew's quarters.
- (24) Motor control switches.
- (25) After escape hatch.
- (26) Expansion chambers for Diesel exhaust.
- (27) Exhaust outlet when submarine is surfaced (now closed by valves).

KEY TO OTHER PARTS

- (28) Tanks.
- (29) Radio and radar room.
- (30) Control room, with Commanding Officer at the periscope.
- (31) Batteries for driving electric motors and supplying lighting, etc.; also wells for periscopes when they are lowered.
- (32) Galley.
- (33) Commanding Officer's cabin.
- (34) Crew's quarters.
- (35) Compressed air bottles for blowing water ballast tanks. Nos. 12, when submarine rises. Water is taken in when submerging.
- (36) Forward torpedo room.
- (37) Forward torpedo firing tubes.
- (38) Forward port hydroplane.
- (39) Torpedo loading hatch.
- (40) Forward escape hatch.
- (41) Conning tower.
- (42) Anti-fouling wires.
- (43) Cruising periscope (extended).
- (44) Radar scanner (extended).



A submarine without the 'snort' apparatus could only remain submerged for about 20 hours, running on its electric motors. It would then have to surface to recharge the batteries by using its Diesel engines, and also renew the air.



THE 'SNORT' IN NATURE

An interesting comparison in this method of breathing under water is the Indian elephant, which is fond of bathing and will often submerge, using its trunk as a breathing tube.

"CUTTY SARK"

THE MOST FAMOUS OF ALL CLIPPERS

The *Cutty Sark* was designed and built in 1869 to rival the *Thermopylae*, another clipper ship, with whom she had many an exciting race bringing the first of the season's tea from China, or the wool from Australia.

She was one of the best loved ships flying the Red Ensign, so a permanent home is going to be found for her in a dry dock, by the *Cutty Sark* Preservation Society.

The *Cutty Sark* is a composite full rigged ship - that is, she has iron frames planked over with wood.

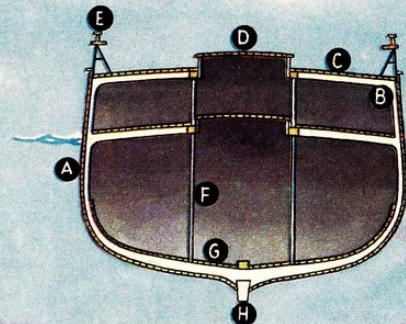
She has three masts, fore, main and mizzen and is essentially an aristocrat of the sailing ship family.

Of some 1,970 tons displacement (i.e. loaded), she has a length of 212½ ft. with a beam of 36 ft. and could carry a cargo of 1,000 tons. The cargo shown here was a typical one from Australia during her famous by-gone days.

You can wear a *Cutty Sark* Badge - see page 13.

KEY TO PARTS

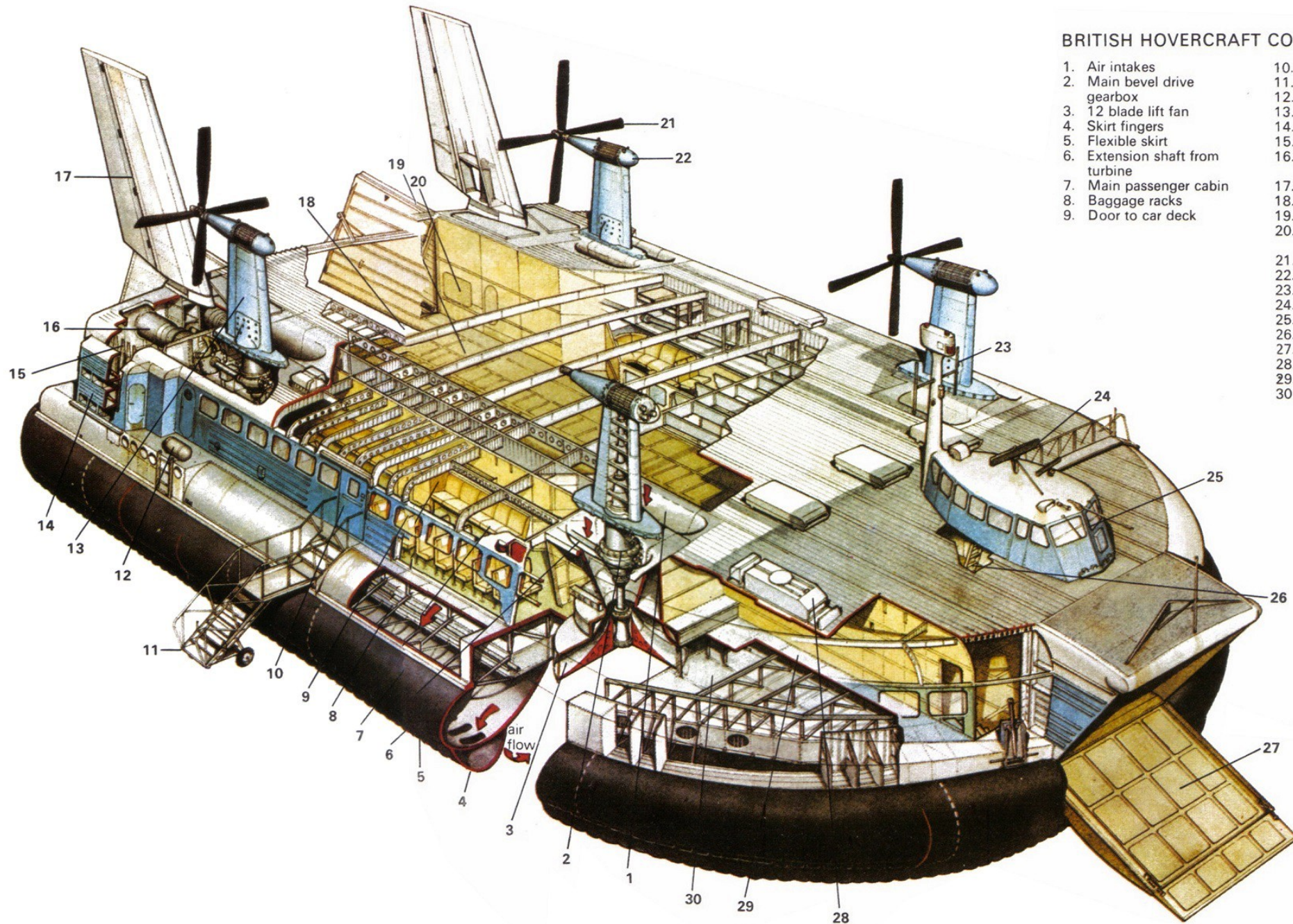
(1) Bowsprit. (2) Figure-head. (3) Star-board anchor and capstan. (4) Lower forecastle with crew space. (5) Forecastle. (6) Fore hatch. (7) Fore mast. (8) Fore-top mast. (9) Fore-top-gallant mast. (10) Midship deck house for crew and galley. (11) 'Tween deck cargo of sheep-skins. (12) Main hold cargo of wool. (13) Main hold cargo of nickel ore, also acts as ballast. (14) Main hatch. (15) Winch. (16) Main mast. (17) Main-top mast. (18) Main-top-gallant mast. (19) Hand pumps. (20) Half-deck house with accommodation for apprentices. (21) After hatch. (22) Mixed cargo. (23) Mizzen mast. (24) Mizzen-top mast. (25) Mizzen-top-gallant mast. (26) Steering wheel. (27) Captain's and First Officer's accommodation with saloon.



Cross section of hull of *Cutty Sark*, showing method of construction.

(A) Wooden outer planking. (B) Iron frames and deck beams. (C) Wooden deck planking. (D) Hatch. (E) Wooden rails on metal bulwarks. (F) Iron stanchions. (G) Wooden hold planking. (H) Iron keel.

BRITISH HOVERCRAFT CORPORATION SR-N4



1. Air intakes
2. Main bevel drive gearbox
3. 12 blade lift fan
4. Skirt fingers
5. Flexible skirt
6. Extension shaft from turbine
7. Main passenger cabin
8. Baggage racks
9. Door to car deck
10. Passenger entrance door
11. Retractable stairs
12. Dinghy pack
13. Pylon
14. Engine air intakes
15. Acoustic baffles
16. Marine Proteus gas turbine
17. Fin
18. Rear car ramp
19. Car deck
20. Hatch to auxiliary power unit
21. HS Dynamics propeller
22. Propeller gearbox
23. Radio aerials
24. Radar scanner
25. Control deck
26. Crew entry ladder
27. Forward car ramp
28. Cabin ventilation pack
29. Forward passenger cabin
30. Forward fuel tank

WORLD of WONDERS

EVERY MONDAY . PRICE 1/6d . No. 19 . 1st AUGUST 1970

Ire 1/10d Australia 25c N. Zealand 25c S. Africa 22c Rhodesia 23c E. Africa 2s 50 W. Africa 2/0 Malaysia 80c Malta 1/9d



**ALL CHANGE
FOR THE
CHUNNEL!** STORY: PAGE 15

WORLD'S MOST POWERFUL DIESEL-ELECTRIC LOCOMOTIVE

(BRITISH RAILWAYS MODERNISATION)



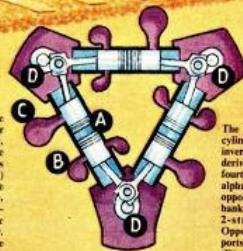
The 3,300 h.p. *Deltic* is the world's most powerful single-unit Diesel-electric locomotive, and 20 of them have been ordered by British Railways for service on the East Coast routes. The *Deltic* is Type CO-CO; this means C for three driving axles to each bogie and O for each axle having its own driving motor.

Built by the English Electric Co. Ltd., these magnificent engines are intended for main line passenger and express freight duties; maximum speed for main line working is 105 m.p.h. The two Napier *Deltic* Diesel engines have 18 cylinders each, arranged in the form of an inverted equilateral triangle. Weight of locomotive in running order, 106 tons - length over buffer beams, 66 ft.

KEY TO HOW IT WORKS

(1) Electric head-lamp. (2) Electric marker-lights. (3) Sand-box filler. (4) Air intake grille for traction motor blower. (5) Exhauster for train vacuum brakes. (6) Air brake reservoir. (7) Air blower for cooling traction motor. (8) Electric leads to traction motors. (9) Electric traction

motor and reduction gearing. There are six in all, one to each driving axle. (10) Air brake cylinders. (11) Warning horns. (12) Control apparatus cubicle. (13) Driver's seat. (14) Air intake grilles to radiators. (15) Radiators for cooling engine. (16) Radiator fans and air outlet. (17) Napier *Deltic* 18 cylinder, 1,650 h.p. Diesel engine. (18) Main electricity generator. The Diesel electric principle is: the Diesel engine drives the generator - the generator supplies current to the traction driving motors. (19) Engine air supply. (20) Exhaust system. (21) Exhaust silencer. (22) Exhaust outlet (each side). (23) Engine air intakes. (24) Air intake grille to steam generator. (25) Train steam-heating generator. (26) Fuel tank. (27) Fuel gauge. (28) Water tank for steam generator - 600 gallons. (29) Fuel tank. Total fuel capacity - 800 gallons. (30) Napier *Deltic* 18 cylinder, 1,650 h.p. Diesel engine. (31) Radiator fan drive shafts. (32) Main generator. (33) Auxiliary generator. (34) Cooling air intake for generator. (35) Driver's instrument panel and master controller. (36) Fireman's seat. (37) Handbrake wheel. (38) Door to nose-end compartment.



The Napier *Deltic* 18-cylinder engine, being of an inverted triangular shape, derives its name from the fourth letter of the Greek alphabet, 'Delta' (Δ). The opposed pistons are in three banks of six cylinders on the 2-stroke principle. (A) Opposed pistons. (B) Inlet ports. (C) Exhaust ports. (D) (D) (D) Crankshafts.

The Crane That Takes The Strain

Giant mobile cranes are revolutionising the way freight is moved from one spot to another

Illustrated by Clifford Meadway

OVER the last ten years, a quiet revolution has taken place within Britain's docks and freight yards. Gone are the days when dockers were forced to queue at 7 a.m. in the hope that there might be work that day; now many harbours are oases of calm, a testimony to the efficiency of the change that swept the industry.

The new technique was called "containerisation". This seemingly complicated word has a simple explanation: instead of a manufacturer loading his goods on to a lorry at his factory, from where they would be taken to the docks to be loaded on to ships by dockers and unloaded again at the other side, all he does is to order a "container".

A container is a large steel box which comes in a range of standard sizes. It can be sealed from the moment it leaves the factory to the moment it reaches its destination.

The advantage of this system is that the possibility of theft and damage is reduced; perhaps most important of all, however, is that it is quicker. Instead of taking several men and many hours to unload and reload a lorry, train or ship, huge container-handling cranes can switch the container from one means of transport to the other in just a few minutes. Working flat-out, one of these cranes can handle up to 360 containers a day—and that is a dramatic improvement on the time it used to take to handle a similar amount of traditional freight.

Let us take a look at one of these powerful monsters at work.

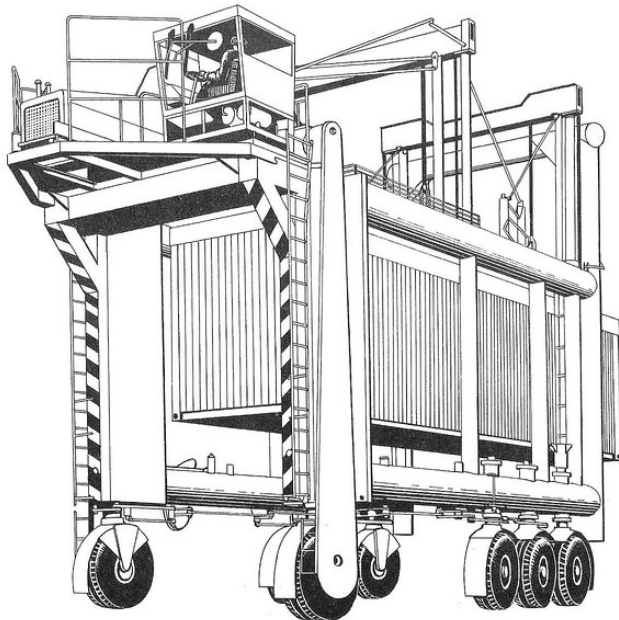
It is an impressive sight. The crane is an Arrol Goliath 2-6-3; the numbers indicate that it can operate over two roadways, six railway tracks and three storage roads.

The Goliath's legs rest on rails which allow the entire piece of equipment to move along the length of a train or a line of trucks. Then the driver's cabin and the grappling assembly (which holds the container) can move sideways across the length of roads, railways and storage areas.

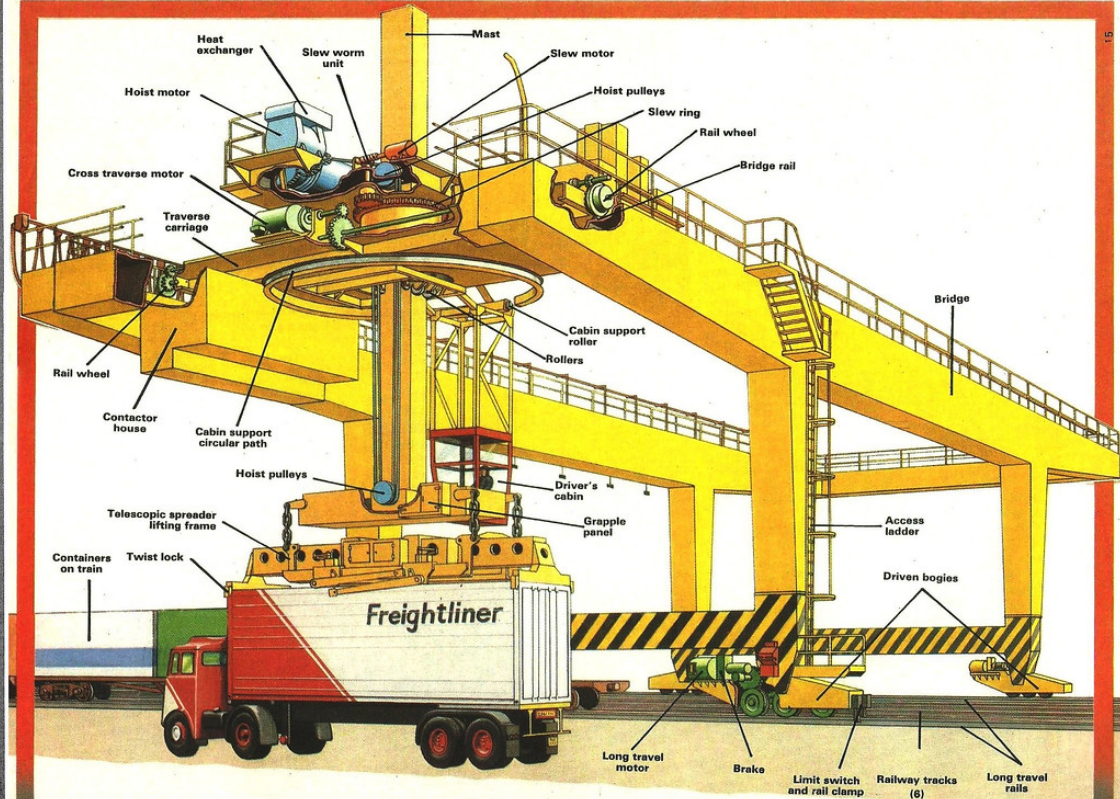
The grappling assembly can rotate through almost a complete circle, and it can also tilt to allow a container to be lifted off a lorry parked on an incline. The crane has been described as being like "a mobile funfair". Certainly, when you see one of these "creatures", with the grappling hooks revolving while it moves both sideways and lengthways along a track, it does remind you of nothing less than an "octopus" at the fair!

Power for these giant cranes comes from a large electrical condenser system. This feeds the controls in the driver's cabin. These only light up when all the lifting connections are perfectly secure.

Suspended high up in his cabin, the driver has a good all-round view and radio connections to the yard office and to the foreman on the ground. In the case of an emergency, a special harness allows the driver to throw himself out of the window—it will slow him down, like a parachute, before he hits the ground!



This Clark eight-wheel straddle carrier is more mobile than the Arrol rail-based crane. Powered by an eight-cylinder diesel engine, it can stack standard 40-foot containers three high.



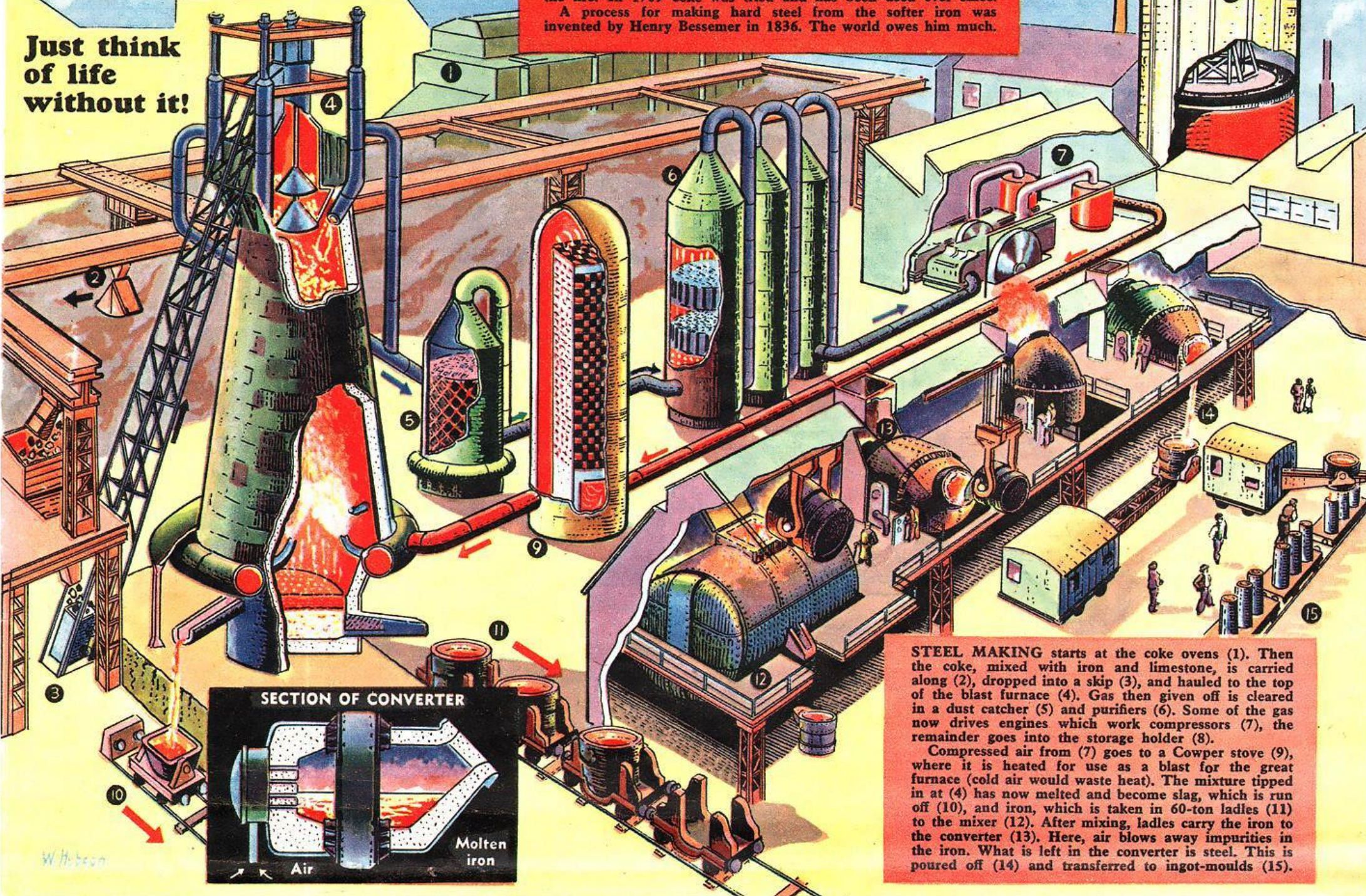
STEEL

Just think
of life
without it!

To make steel we must first make iron. It is uncertain how man first discovered iron, but it was known at least 7,000 years ago, because an iron blade has been discovered in one of the pyramids of Egypt. For hundreds of years the process was simply to heat small lumps of iron ore in an open fire and then hammer the ore into the shape needed with stones.

By the 13th century the furnace had come into being. The trouble was the iron ore had to be laid directly on to the fuel, usually charcoal, and was such a weight that it tended to put out the fire. In 1709 coke was tried and has been used ever since.

A process for making hard steel from the softer iron was invented by Henry Bessemer in 1836. The world owes him much.



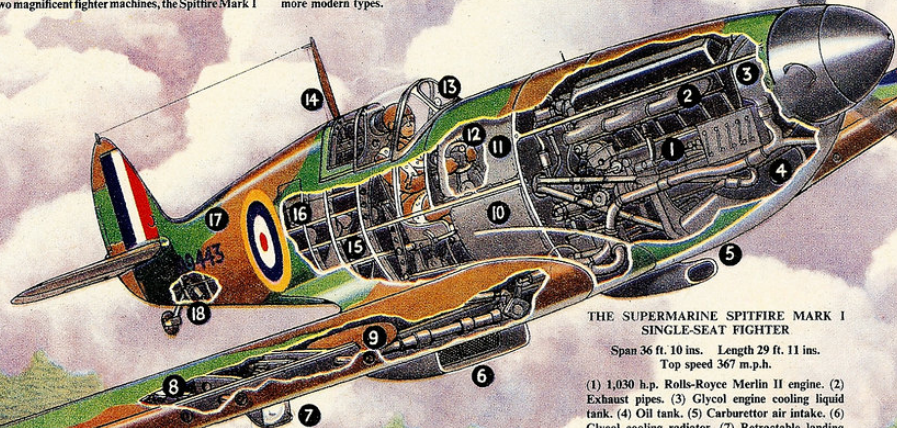
STEEL MAKING starts at the coke ovens (1). Then the coke, mixed with iron and limestone, is carried along (2), dropped into a skip (3), and hauled to the top of the blast furnace (4). Gas then given off is cleared in a dust catcher (5) and purifiers (6). Some of the gas now drives engines which work compressors (7), the remainder goes into the storage holder (8).

Compressed air from (7) goes to a Cowper stove (9), where it is heated for use as a blast for the great furnace (cold air would waste heat). The mixture tipped in at (4) has now melted and become slag, which is run off (10), and iron, which is taken in 60-ton ladles (11) to the mixer (12). After mixing, ladles carry the iron to the converter (13). Here, air blows away impurities in the iron. What is left in the converter is steel. This is poured off (14) and transferred to ingot-moulds (15).

THE BATTLE OF BRITAIN AIRCRAFT

Next week the Royal Air Force will commemorate the anniversary of the Battle of Britain of 1940. We think, therefore, that it is a fitting occasion on which to show the aircraft which defended this country against the machines of the German Luftwaffe (Air Force) twelve years ago. These two magnificent fighter machines, the Spitfire Mark I

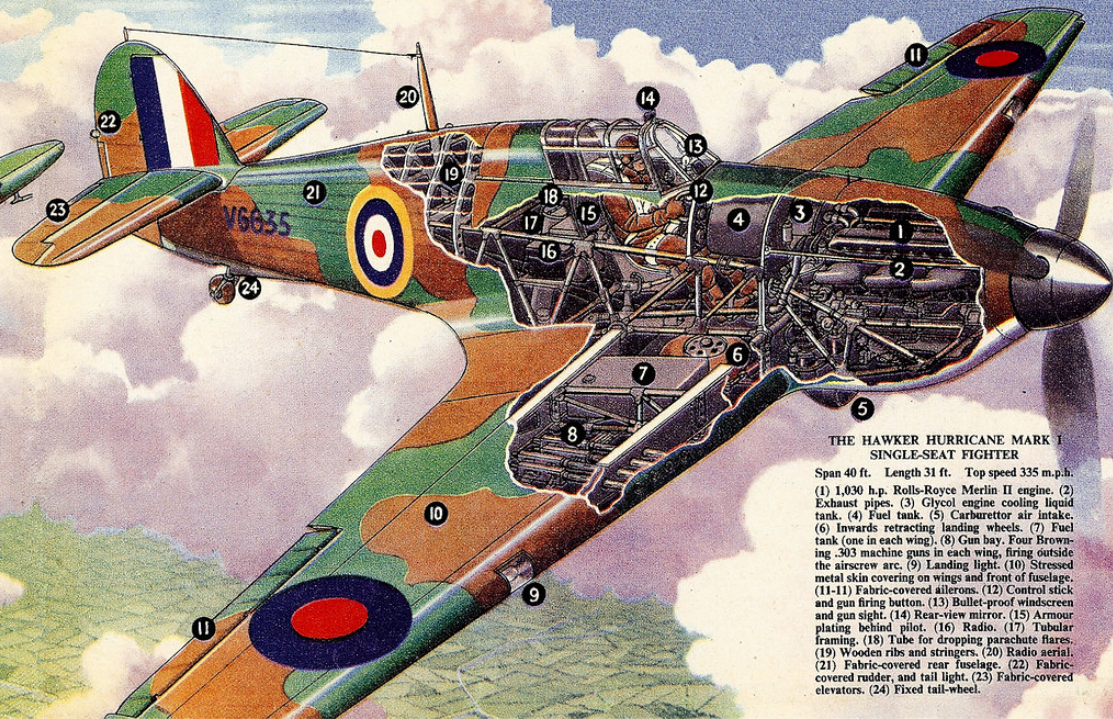
and the Hurricane Mark I, were both powered by the famous Rolls-Royce Merlin II engine. Although now out of date, they (and their pilots) created a record second-to-none in aerial combat against all types of German aircraft. It is interesting to compare their design with that of more modern types.



THE SUPERMARINE SPITFIRE MARK I
SINGLE-SEAT FIGHTER

Span 36 ft. 10 ins. Length 29 ft. 11 ins.
Top speed 367 m.p.h.

- (1) 1,030 h.p. Rolls-Royce Merlin II engine. (2) Exhaust pipes. (3) Glycol engine cooling liquid tank. (4) Oil tank. (5) Carburettor air intake. (6) Glycol cooling radiator. (7) Retractable landing light. (8) Gun bay. Four Browning .303 machine guns in each wing, firing outside the airscrew arc. (9) Outwards retracting landing wheels. (10) Lower fuel tank. (11) Upper fuel tank. (12) Control stick and gun firing button. (13) Bullet-proof windscreen and gun sight. (14) Radio aerial. (15) Tubes for dropping parachute flares. (16) Radio. (17) All-stressed metal skin covering. (18) Tail wheel shock absorber.



THE HAWKER HURRICANE MARK I
SINGLE-SEAT FIGHTER

Span 40 ft. Length 31 ft. Top speed 335 m.p.h.

- (1) 1,030 h.p. Rolls-Royce Merlin II engine. (2) Exhaust pipes. (3) Glycol engine cooling liquid tank. (4) Fuel tank. (5) Carburettor air intake. (6) Inwards retracting landing wheels. (7) Fuel tank (one in each wing). (8) Gun bay. Four Browning .303 machine guns in each wing, firing outside the airscrew arc. (9) Landing light. (10) Stressed metal skin covering on wings and front of fuselage. (11-12) Fabric-covered ailerons. (12) Control stick and gun firing button. (13) Bullet-proof windscreen and gun sight. (14) Rear-view mirror. (15) Armour plating behind pilot. (16) Radio. (17) Tubular framing. (18) Tube for dropping parachute flares. (19) Wooden ribs and stringers. (20) Radio aerial. (21) Fabric-covered rear fuselage. (22) Fabric-covered rudder, and tail light. (23) Fabric-covered elevators. (24) Fixed tail-wheel.

A Royal Car

KEY TO ENGINE AND CHASSIS

(1) Headlamps. (2) Pass-lamps and fog-lamps. (3) Independent front wheel coil spring suspension. (4) Two-leading-shoe type front hydraulic brake drum. (5) 36 h.p. 'straight-eight' overhead valve Daimler engine. (6) Air intake silencers of twin carburettors. (7) Dynamo. (8) Distributor head of coil ignition. (9) Starter motor. (10) Fluid flywheel. (11) Epicyclic gearbox with four forward speeds and reverse. (12) Gear selecting linkage from hand lever on steering column. (13) Gear pedal, foot brake pedal (hydraulic) and accelerator pedal. (14) Hand lever on steering column selects the gear required and the gear pedal, when depressed and released engages the gear selected. (15) Hand brake lever (pulled on). This operates the back wheel brakes mechanically and independently. (16) Propeller shaft and exhaust silencer. (17) Hypoid bevel type back axle drive and differential.

KEY TO SPECIAL FEATURES

(17) Electric motor and relay for operating door window. All door windows are electrically operated. (18) Push button switches for operating window. (19) Small rear window. (20-20). Push-button switches for operating sliding roof shutter. (21) Near side reading lamp turned in. (22) Offside reading lamp extended. These lamps are screened from the chauffeur. (23) Near side occasional seat folded down. (24) Electric motor and relay for operating the glass divisional panel behind chauffeur's and footman's seats. (25) Sliding glass panel. (26) Hand mirror, cigarette lighter, etc. (27) Push-button switch for individual roof light. (28) Radio set in folding arm rest. (29) Push button switch for operating glass divisional panel. (30) Blind. (31) Individual roof light. (32) Division of landaulette body which folds back. (33) Safety glass panel in roof, covered at will by electrically operated sliding shutter. (34) Clock. (35) Position of Royal Standard and Shield when in use. (36) Blue police signal lamp. (37) Alternative position of Royal Standard on offside wing. (38) No identification plate.

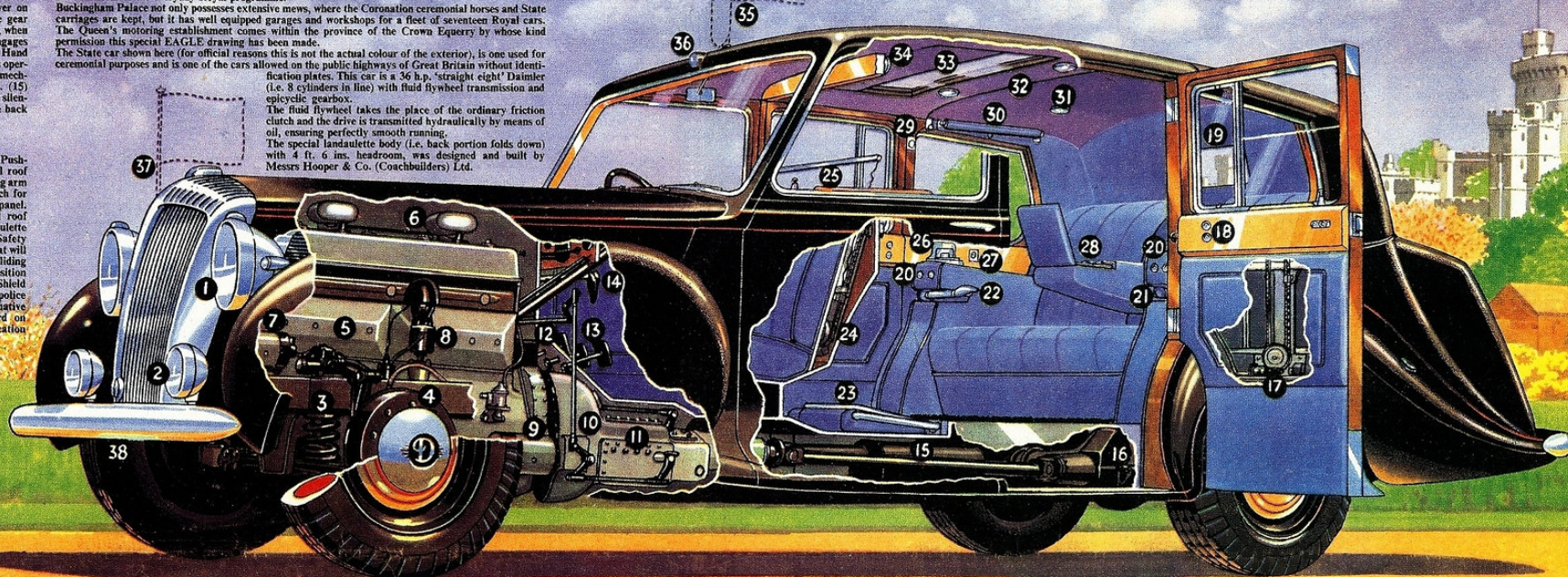
Our Royal Family have been motorists for more than 40 years, and today the Royal cars are essential to the fulfilment of the everyday Royal programme.

Buckingham Palace not only possesses extensive mews, where the Coronation ceremonial horses and State carriages are kept, but it has well equipped garages and workshops for a fleet of seventeen Royal cars. The Queen's motoring establishment comes within the province of the Crown Equerry by whose kind permission this special EAGLE drawing has been made.

The State car shown here (for official reasons this is not the actual colour of the exterior), is one used for ceremonial purposes and is one of the cars allowed on the public highways of Great Britain without identification plates. This car is a 36 h.p. 'straight eight' Daimler (i.e. 8 cylinders in line) with fluid flywheel transmission and epicyclic gearbox.

The fluid flywheel takes the place of the ordinary friction clutch and the drive is transmitted hydraulically by means of oil, ensuring perfectly smooth running.

The special landaulette body (i.e. back portion folds down) with 4 ft. 6 ins. headroom, was designed and built by Messrs Hooper & Co. (Coachbuilders) Ltd.



TIP-UP CARS AND TWO-LEVEL TOWNS - *That's how they'll beat the traffic jams*

Thirty million cars on the roads by the year 2000. That is the experts' forecast. How will our major cities cope with the problem of providing for the vast army of travellers - nearly four times the present size? On these two pages, we look at some of the solutions which have been put forward.

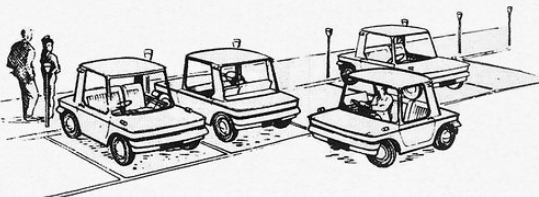
ONE brilliant idea to help solve the present-day traffic and parking problems is the single-seater commuter's mini-car designed by Mr Dennis Adams of Marcos Cars Ltd., Bradford-on-Avon.

Mr Adams's brain-child - which he hopes will be in production by the end of the year - will be 8 ft. long with a fibreglass body on a chassis of tough marine plywood. It will be powered by a zippy 250 c.c. motor cycle engine mounted between the rear wheels which will provide an excellent acceleration and a top speed of 65 m.p.h. The driver gets in and out by raising the roof canopy.

The main feature of this revolutionary mini-car is that it will require the absolute minimum of parking space (it can be parked by tipping it up on its tail!). Owing to its super lightweight construction, the vehicle can be easily pivoted by the frailties of people and rests on aluminium 'buffers'. When parked, it will occupy an area of just one square yard.

What happens to the fuel when the car is tipped up?

A spokesman for the firm said that no trouble is expected from that quarter, as a leak-proof, sealed fuel-filler cap is being specially designed; also, the vehicle will be using a two-stroke engine, lubricated



Designed by Eric J. Roberts, of Backwell, Somerset, these three-seat mini-cars have front wheels that can point completely sideways, allowing the cars to turn about the centre of their rear axles.

by the oil mixed with the petrol, so there will be no oil-filled sump to worry about. Price of a fully-equipped de luxe model will be in the region of £350.

ELECTRIC TAXI CABS

The United States, land of super multi-lane freeways and 1,000-mile expressways, is also plagued with city traffic problems. Mr Raymond Loewy, one of America's top car designers, has a way-out plan to free big cities of traffic congestion. He suggests that all private cars - except emergency vehicles - should be banned from the streets. In their place, Mr Loewy would install a fleet of self-drive electric taxi cabs. Electric charging points would be placed at frequent intervals along the kerbs of the city's pavements into which the *Electrocabs* would be plugged in, head-on. Each citizen would have a personal key-plate which he would insert into a slot on the vehicle's dashboard. The key would release the cab's front plug from the pavement point, allowing the vehicle to be driven off; a fare-meter would start ticking away as soon as the taxi left its charging point. When the driver comes to his journey's end, he plugs the *Electrocab* into a nearby point and collects a receipt from a dashboard machine. He settles up his bill at the end of each month.

At a recent discussion held in London

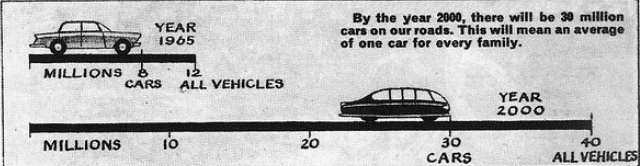
on the subject 'Transport in the year 2000', several eminent experts predicted the following types of vehicles: a man-powered pedal flying machine aided by a lightweight 5 h.p. motor (man himself is only capable of sustaining a miserable half horse power), and an electrically-driven bubble car which could move equally well in all directions. The 'sky-bike' would be cheap to produce and would be ideal for short distances.

But the best bet for future city travel will be the 'mini-copter', of which several models are now being developed. One model, the *Muncie 18 Aircar*, is claimed to be the safest machine ever to fly, and the easiest to learn to control; anyone can become proficient in driving the aircar after only six hours' instruction!

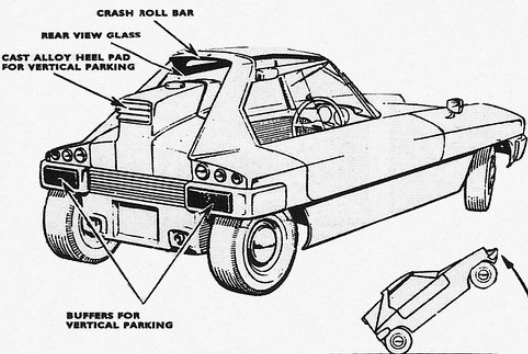
JAY-WALKER DANGER

But even if city traffic does take to the air in the future, there will still be the danger of jay-walkers - for personal *Rocket Belts* are now being brought to a high pitch of perfection in the United States and are capable of lifting a man to heights of 200 feet and propelling him for long distances.

But there again, things should be pretty well organized by the year 2000 and it is certain that policemen, mounted on 'flying platforms', will be busy engaged on 'sky traffic control'.



This three-quarter rear view of the Marcos project shows the flat tail on which the single-seater car will rest when tipped up (see small sketch).



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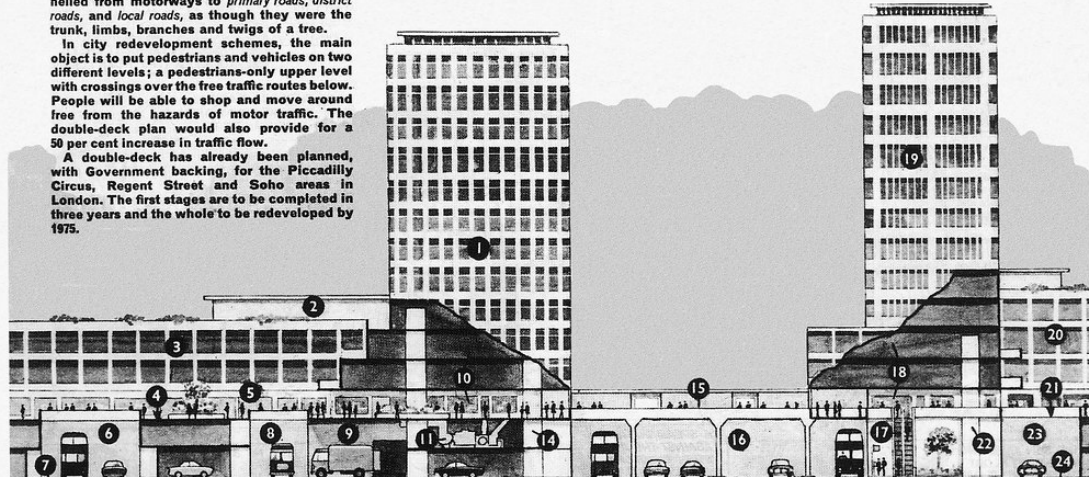
THE vast growth of future traffic (see diagram on right) will create many problems in our already congested cities and towns.

To cope with this, full-scale redevelopment schemes have been drawn up and reports made to the Ministry of Transport by Professor C. D. Buchanan.

The main plan seems to be a network of distributor roads - where traffic would be channelled from motorways to primary roads, district roads, and local roads, as though they were the trunk, limbs, branches and twigs of a tree.

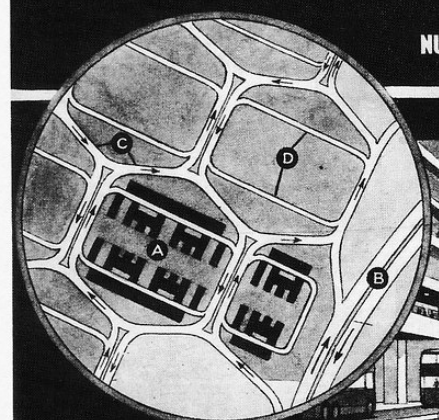
In city redevelopment schemes, the main object is to put pedestrians and vehicles on two different levels; a pedestrians-only upper level with crossings over the free traffic routes below. People will be able to shop and move around free from the hazards of motor traffic. The double-deck plan would also provide for a 50 per cent increase in traffic flow.

A double-deck has already been planned, with Government backing, for the Piccadilly Circus, Regent Street and Soho areas in London. The first stages are to be completed in three years and the whole to be redeveloped by 1975.



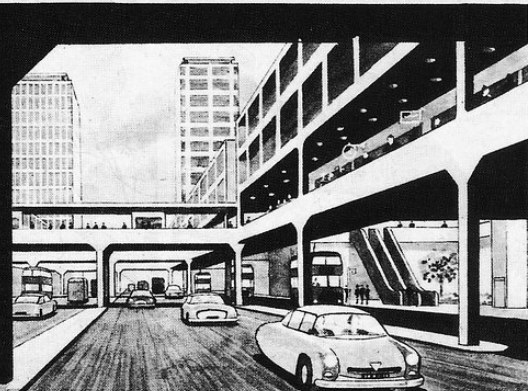
KEY TO NUMBERED PARTS

- (1) Shops and hotel. (2) Cinema. (3) Shops and restaurants. (4) Pedestrians-only, upper-level. (5) Amusement area. (6) One-way district traffic road. (7) Water, electricity, telephone mains, etc. (8) Local access road. (9) Loading bay for shops. (10) Shops at upper-level. (11) Air-conditioning plant.
- (12) Underground car parks. (13) Lift machinery. (14) Lifts. (15) Pedestrian crossing at upper-level. (16) Primary traffic road. (17) Escalators to ground level for bus stops. (18) Shops at upper-level. (19) Shops and offices. (20) Shops. (21) Pedestrians-only, upper level 'walking'. (22) Lifts. (23) One-way district traffic road. (24) Gas, water, electricity mains, etc.



An ideal system for the future development of new towns or suburbs - a one-way hexagonal system of roads which gives a good distribution of traffic with no cross-roads.

KEY: (A) Shops and residential area in each hexagon. (B) Primary traffic road. (C) District distributor roads. (D) Local distributor and access roads to shops, etc.



An impression of a city street in the future, looking along the primary traffic route at ground-level, with pedestrian-crossings, shops at upper-level

ASHWELL WOOD

109—NOT OUT

BRUNEL'S FAMOUS BRIDGE, OPENED IN 1859,
TO BE TESTED FOR HEAVIER TRAIN LOADS

AN EAGLE
cutaway
DRAWING



During tests on a 9 ft. 6 ins. long perspex model, scientists hung weights on the main girder to represent train loads. New diagonal bracing will be installed on the vertical struts.

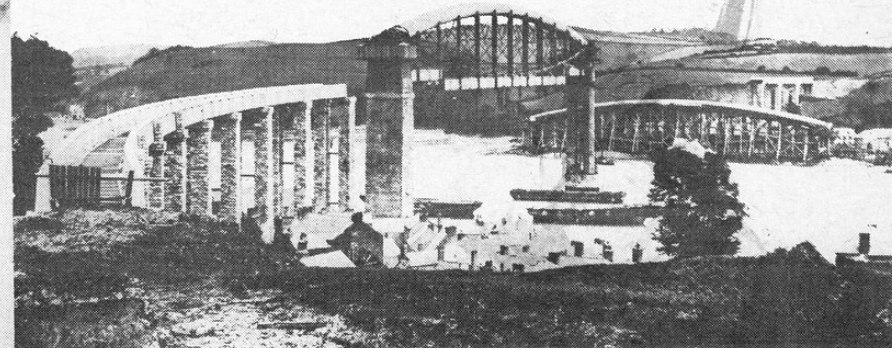
British rail scientists at Derby are going to find out if the 109-years-old Royal Albert Bridge at Saltash, which links Devon and Cornwall across the river Tamar, can withstand heavier train loads. They have built a perspex model of the bridge which will be weight-tested almost to the point of destruction. Designed and built by Isambard Kingdom Brunel, the bridge is still in very good condition. The bridge, opened by Prince Albert on May 2nd, 1859, has a single track and carries the only railway link with Cornwall — the main line from London to Penzance. It has two main spans of 455 ft. and is unique in construction, being a combination of an arch and a suspension bridge; the most interesting points are the immense wrought-iron tubes that arch upwards. Almost alongside, the new Tamar Suspension Bridge carries a 33 ft. road across the river.

KEY TO NUMBERED PARTS

(1) Rock formation of river bed. (2) Mud deposit, 16 feet thick. (3) Centre pier of masonry, built on rock 85 ft. below high water level. (4) Four octagonal, cast iron columns set in centre pier. (5) Height of main girder from high water level—110 ft. (6) River Tamar is 1,100 feet wide at this point. (7) Shore pier of masonry. (8) One of the seven land spans on the Devon side. (9) Railway approach viaduct — total length of bridge is 2,220 feet. (10) Support trusses and 33 ft. wide roadway of the new Tamar Suspension Bridge. (11) Main suspension cables of new bridge. (12) Cast-iron portal supporting the arch and suspension chains of the railway bridge. (13) Arch expansion plate. (14) Walk-way on top of bridges. (15-16) Outward thrust

of arch is counterbalanced by inward drag of chains. (17) Vertical struts and diagonal bracing, supporting the main girder. (18) Main girder and single railway track. (19) Each main truss has a span of 455 ft. and weighs 1,060 tons. (20) One of the main towers of the new road bridge which has a centre span of 1,000 ft. and land spans of 374 feet. (21) The ten land spans on the Cornish side which curve away to Saltash station.

A wonderful photograph taken 110 years ago showing one of the main trusses, weighing 1,060 tons, being assembled on the shore. Both trusses were floated out on barges and raised 110 feet by hydraulic jacks — an astounding achievement for those days and a great tribute to the genius of Brunel



Faster Faster Faster

The most coveted prize in motoring, the World Land Speed Record, has inspired the most in human courage and skill since the beginning of this century.

France, Germany and the United States have all competed with Britain for the Record, but it has been entirely in British hands since 1929.

As the years have passed, new knowledge has been gained for the benefit of all motorists. But from time to time, the price of progress has been paid and brave men have died.

The World Land Speed Record is controlled by an international governing body, which lays down strict rules governing the event—a car must twice cover a measured mile which is exact to the last inch. Two runs timed to an accuracy of 100th of a second must be made within one hour and it is the average speed which decides the issue.

The first official record shown on this page was in 1925 by Malcolm Campbell and now, in 1964, his son Donald is the first man to reach over 400 m.p.h. with the new record standing at 403.10 m.p.h.—another fine British achievement.

KEY TO THE FIRST BLUEBIRD :—

(1) Air intake to carburettors. (2) Water tank. (3) 12-cylinder supercharged Rolls Royce 'R' aero engine. This was the forerunner of the famous Merlin which powered the Battle of Britain Spitfires. (4) Outside exhaust. (5) Three-speed gearbox. (6) Offset propeller shaft. (7) Final drive.

KEY TO THUNDERBOLT :—

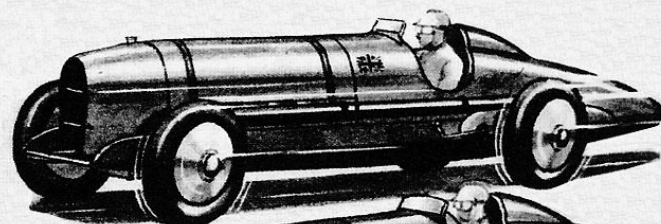
(8) Radiators. (9) Narrow-track front steering wheels. (10) Supercharger air intakes. (11) Supercharger. (12 and 13) Two 12-cylinder supercharged Rolls-Royce 'R' aero engines. (14) Side exhaust. (15) Top exhausts. (16) Traverse gear drive. (17) Final bevel drive.

KEY TO RAILTON SPECIAL :—

(18) Light aluminium body. (19) Front-wheel drive. (20) Three-speed gearbox. (21) 12-cylinder supercharged Napier Lion aero engine driving rear wheels. (22) Top exhausts. (23) Napier Lion engine driving front wheels. (24) Rear-wheel drive. (25) Lower exhausts.

KEY TO PROTEUS BLUEBIRD :—

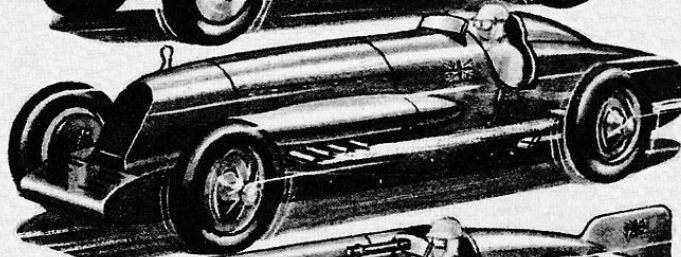
(26) Front-wheel drive. (27) Reduction gears. (28) Engine accessories. (29) British Proteus gas turbine engine. (30) Air intakes. (31) Turbine casing. (32) Exhaust manifolds. (33) Rear wheel drive.



150.87 m.p.h.

1925

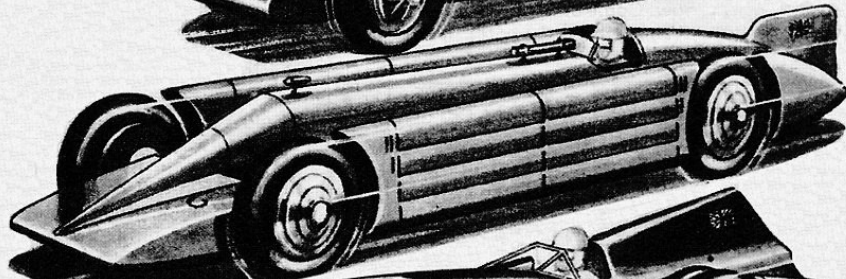
350 h.p. Sunbeam—M. Campbell, Pendine Sands, Wales.



174.88 m.p.h.

1927

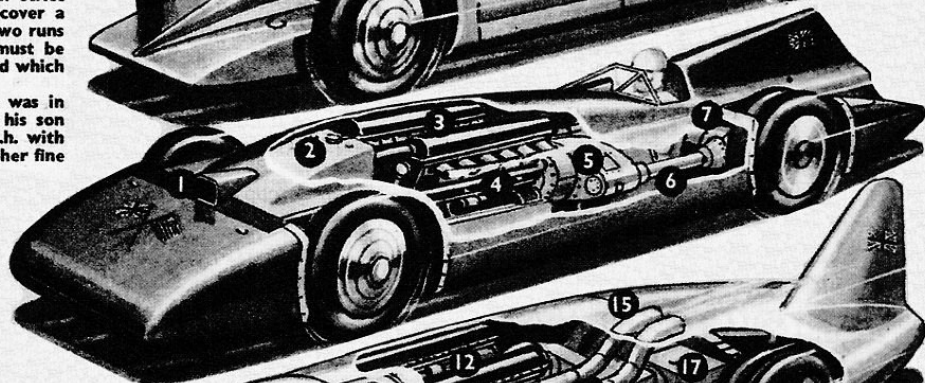
500 h.p. Napier Lion—M. Campbell, Pendine Sands, Wales.



231.44 m.p.h.

1929

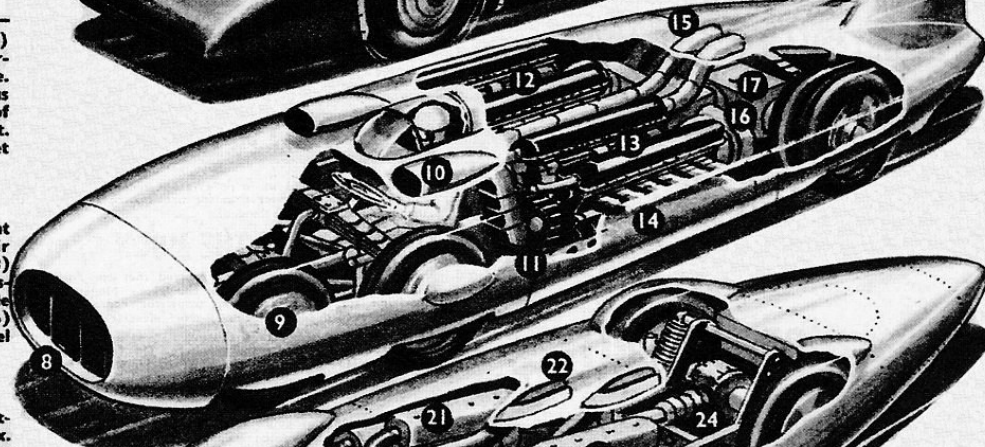
930 h.p. Napier Lion—The Golden Arrow—H. Segrave, Daytona Beach, Florida.



301.13 m.p.h.

1935

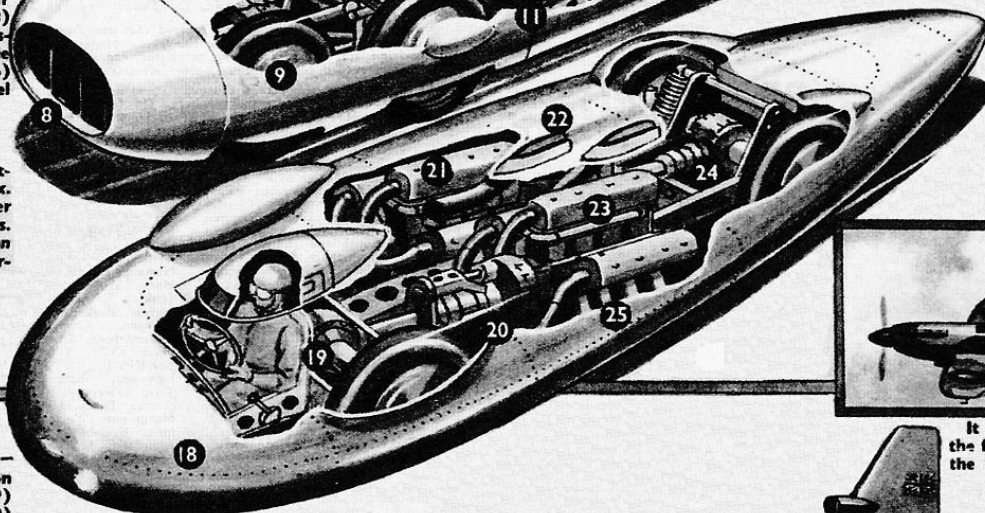
2,500 h.p. Rolls-Royce 'R'—The Bluebird—M. Campbell, Bonneville, Utah.



357.50 m.p.h.

1938

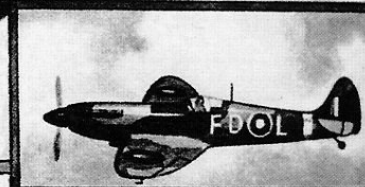
5,000 h.p. Two Rolls-Royce 'R'—The Thunderbolt—G. Eyston, Bonneville, Utah.



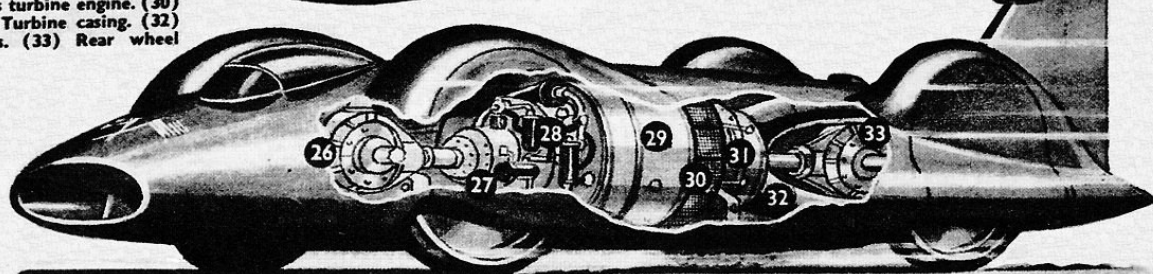
394.20 m.p.h.

1947

2,500 h.p. Two Napier Lion—Railton Special—J. Cobb, Bonneville, Utah. This record stood for 17 years up to 1964.



It is interesting to recall that the fastest Spitfire at the end of the war—1945—was 450 m.p.h.



403.10 m.p.h.

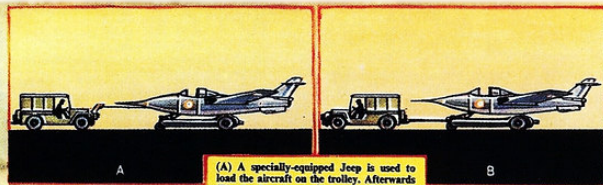
1964

4,250 h.p. Bristol Proteus Gas Turbine—Bluebird—D. Campbell, Lake Eyre, Australia. The present record.

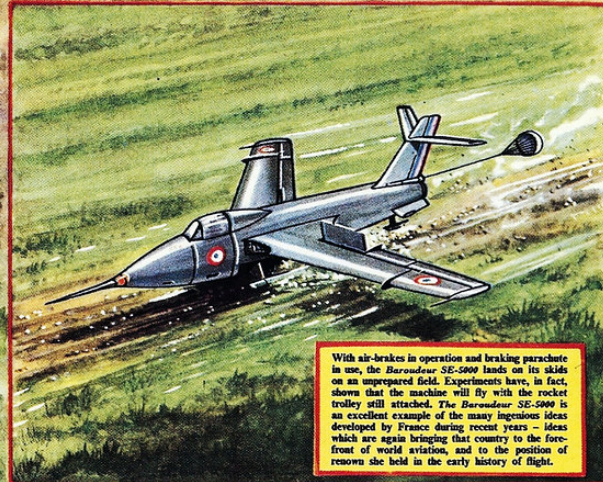
A FRENCH EXPERIMENTAL AIRCRAFT—THE BAROUEUR SE-5000

At the outbreak of World War II, the French Air Force was ill-equipped to deal with the might of the German Luftwaffe. Although France had an advanced air-fleet on the drawing-boards, she had an obsolete one in the air, due to an unfortunate lethargy which overcame the French aircraft industry between the two World Wars. Today, however, there is a distinct change, and French ingenuity and inventiveness have developed some revolutionary types — particularly in regard to the considerable amount of experimental work carried out with aircraft suitable for N.A.T.O. One requirement is for an aircraft capable of taking off and landing on unprepared grass fields. The *Baroudeur SE-5000* is a French answer to this problem. The aircraft — a light-fighter — is launched from a rocket-propelled trolley and lands on skids. At take-off speed, the pilot cuts the trolley loose and climbs away; meanwhile, the trolley is braked automatically. Our main drawing depicts a *Baroudeur SE-5000* as it is on the point of taking off from its trolley, the actual take-off run being less than 770 yards.

KEY TO NUMBERED PARTS: (1) 30 mm. gun, fitted port and starboard. (2) Gun-sight. (3) Quick-release cockpit canopy. (4) Ejector seat. (5) Oxygen cylinders. (6) Radio equipment. (7) Port wing root air-intake. (8) Skid retracted into fuselage. (9) Air-brakes. (10) Fuel tanks. (11) Rocket-propelled trolley fitted with automatic brakes. (12) Port rocket tubes. Two more tubes are fitted in a similar position on the starboard side of the trolley. The four rockets provide sufficient speed to launch the 'plane. (13) Jet power unit. (14) Strake. (15) Braking parachute, stowed.



(A) A specially-equipped Jeep is used to load the aircraft on the trolley. Afterwards (B), the Jeep is turned round and, with a tow-bar in position, tows the aircraft and trolley to the take-off area.



With air-brakes in operation and braking parachute in use, the *Baroudeur SE-5000* lands on its skids on an unprepared field. Experiments have, in fact, shown that the machine will fly with the rocket trolley still attached. The *Baroudeur SE-5000* is an excellent example of the many ingenious ideas developed by France during recent years — ideas which are again bringing that country to the forefront of world aviation, and to the position of renown she held in the early history of flight.

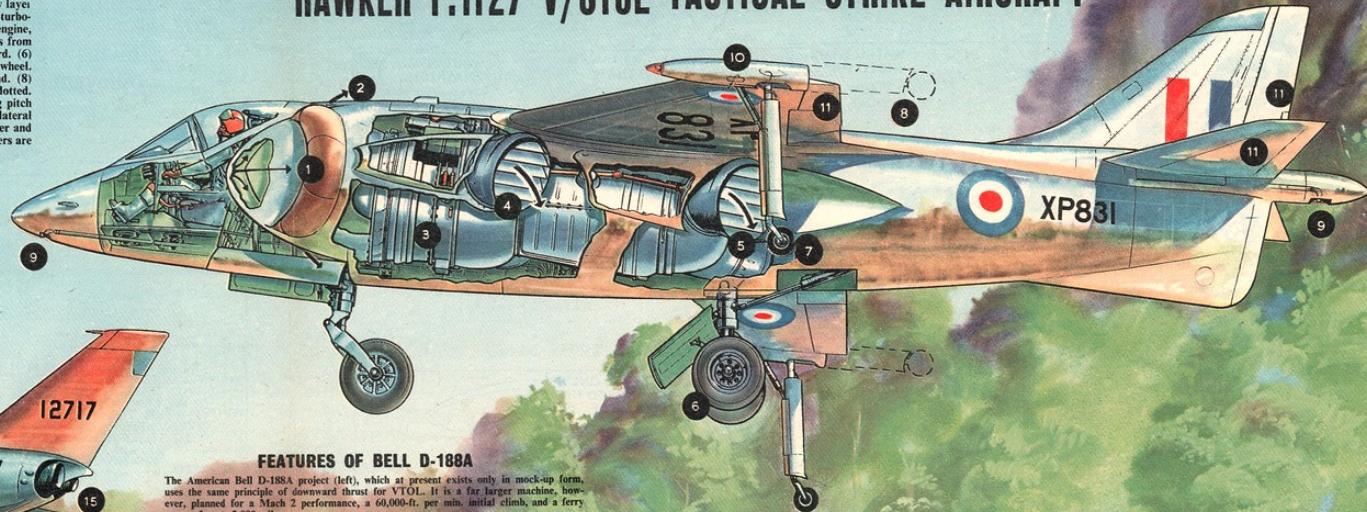
VERTICAL TAKE-OFF WARPLANES

One of the most radical aircraft to be flown since the advent of the first jets is the Hawker P.1127 vertical take-off and landing fighter-bomber. This aircraft is designed to operate from tiny makeshift launching-sites or airstrips which can be rapidly moved about, and set up with rudimentary mobile workshop and operational facilities in any clear space or field. Squadrons of such aircraft, which can either take off vertically (VTOL) or with a very short run (STOL), or operate conventionally from a normal airfield, should be able to give the closest air support to ground forces yet achieved. The revolutionary feature of the P.1127 is the special jet engine, which has four nozzles that can be rotated through approximately 90 degrees to direct the propulsion jets directly downward for VTOL, or in any intermediate direction to directly aft, to give either STOL or conventional take-offs and normal high-speed (transonic) flight.

FEATURES OF HAWKER P.1127

(1) Variable area intake to turbojet. (2) Boundary layer bleed exit. (3) Bristol Siddeley BS.53 lift-thrust turbojet. (4) Rotatable nozzles from fan section of engine, directing thrust downward. (5) Rotatable nozzles from hot section of engine, directing thrust downward. (6) Main double-landing wheels, in tandem with nose-wheel. (7) Outrigger wheels steady machine on ground. (8) Position of outrigger wheels in flight are shown dotted. (9) Small nose-and-tail control-jets give hovering pitch control. (10) Small wingtip control-jets give lateral hovering control. (11) Conventional ailerons, rudder and slab tailplane give control in normal flight. Hawkers are already working on new supersonic designs.

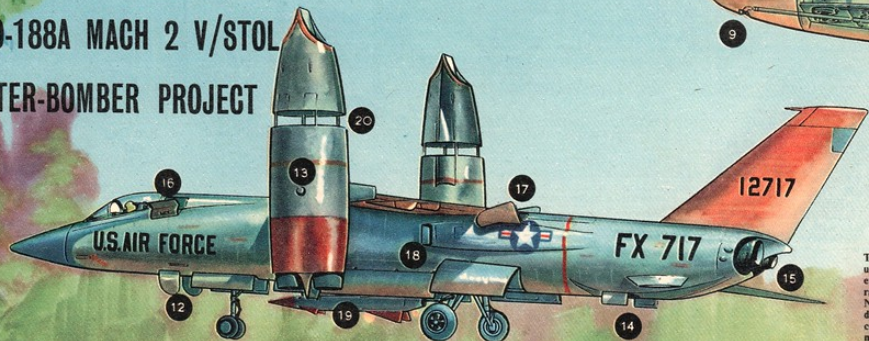
HAWKER P.1127 V/STOL TACTICAL STRIKE AIRCRAFT



FEATURES OF BELL D-188A

The American Bell D-188A project (left), which at present exists only in mock-up form, uses the same principle of downward thrust for VTOL. It is a far larger machine, however, planned for a Mach 2 performance, a 60,000-ft. per min. initial climb, and a ferry range of up to 2,000 miles. No less than eight low-medium power General Electric J85-S-GE turbojets are used, delivering a total of 25,600 lb. s.t. at take-off. Two are positioned just aft of the cockpit (12), giving purely vertical thrust, two with after-burning are carried in each wing-tip nacelle (13), which can be rotated 100 degrees from the over-vertical position shown to a normal horizontal flight position; a further two engines, also with after-burning, are installed in the rear fuselage, their thrust being directed downward (14), or through the normal tailpipes (15) for level flight. Other features are: (16) Air-intake doors for front engines; (17) Intake doors for aft engines (VTOL); (18) Supersonic intakes for aft engines (level flight); (19) Guided missile armament extended from enclosed bomb-bay; (20) Extra VTOL intake area provided by extending nacelle noses upward; (21) Portable VTOL launching pad.

BELL D-188A MACH 2 V/STOL FIGHTER-BOMBER PROJECT



-ROY CROSS-

THE DUKE'S HELICOPTER

Just before the Coronation H.R.H. the Duke of Edinburgh made history by flying from the grounds of Buckingham Palace and landing there again by helicopter.

This has given a great new boost to British aviation and has shown that this British-built aircraft is as safe as a car and a lot more swift and convenient.

The naval helicopter, shown here piloted by Lieut-Commander H.R. Spedding who flew the Duke, is known as the Westland-Sikorsky S-55 and is powered by a 600 h.p. Pratt and Whitney Wasp radial engine.

It has a range of 400 miles, a maximum speed of 112 m.p.h. and a vertical rate of climb of 400 ft. per minute.

We show the troop carrying type, but it can be

converted to carry six stretchers or six passengers, luggage and freight.

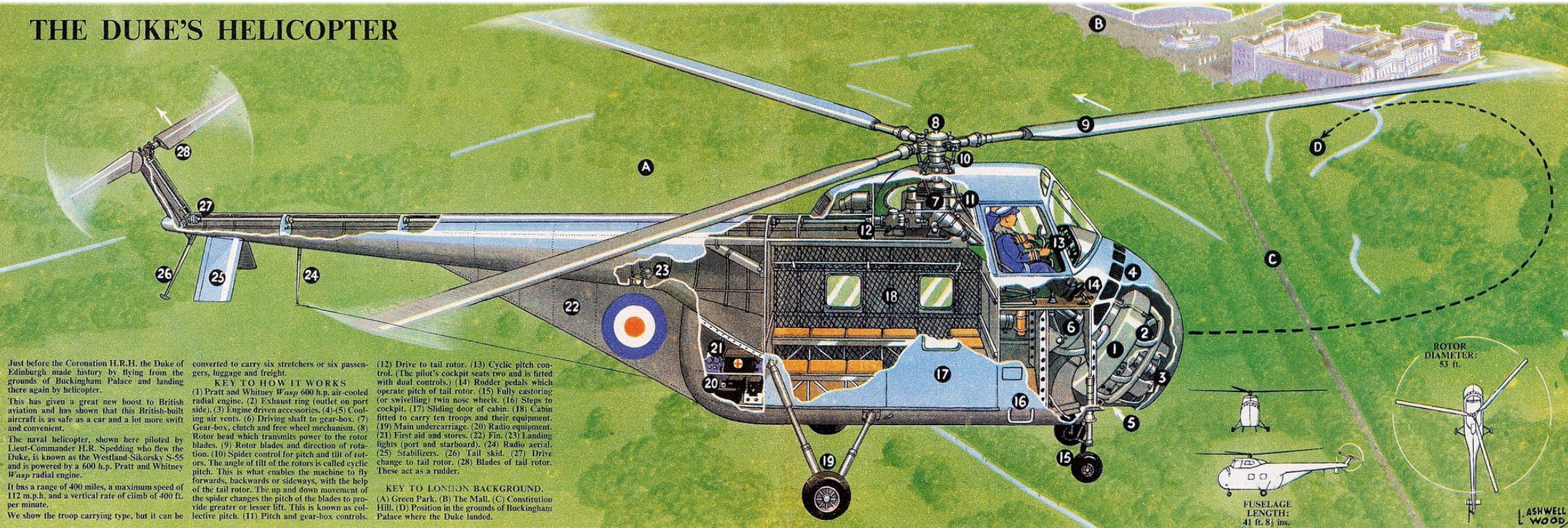
KEY TO HOW IT WORKS

(1) Pratt and Whitney Wasp 600 h.p. air-cooled radial engine. (2) Exhaust ring (outlet on port side). (3) Engine driven accessories. (4)-(5) Cooling air vents. (6) Driving shaft to gear-box. (7) Gear-box, clutch and free wheel mechanism. (8) Rotor head which transmits power to the rotor blades. (9) Rotor blades and direction of rotation. (10) Spider control for pitch and tilt of rotors. The angle of tilt of the rotors is called cyclic pitch. This is what enables the machine to fly forwards, backwards or sideways, with the help of the tail rotor. The up and down movement of the spider changes the pitch of the blades to provide greater or lesser lift. This is known as collective pitch. (11) Pitch and gear-box controls.

(12) Drive to tail rotor. (13) Cyclic pitch control. (The pilot's cockpit seats two and is fitted with dual controls.) (14) Rudder pedals which operate pitch of tail rotor. (15) Fully castoring (or swivelling) twin nose wheels. (16) Steps to cockpit. (17) Sliding door of cabin. (18) Cabin fitted to carry ten troops and their equipment. (19) Main undercarriage. (20) Radio equipment. (21) First aid and stores. (22) Fin. (23) Landing lights (port and starboard). (24) Radio aerial. (25) Stabilizers. (26) Tail skid. (27) Drive change to tail rotor. (28) Blades of tail rotor. These act as a rudder.

KEY TO LONDON BACKGROUND.

(A) Green Park. (B) The Mall. (C) Constitution Hill. (D) Position in the grounds of Buckingham Palace where the Duke landed.



AIR-SEA RESCUE AND 'SARAH'

The problem of locating an air-crash survivor, or an airman who has baled out, in a sea area that may extend hundreds of miles in any direction, is so difficult as to be almost impossible without the use of radio communication.

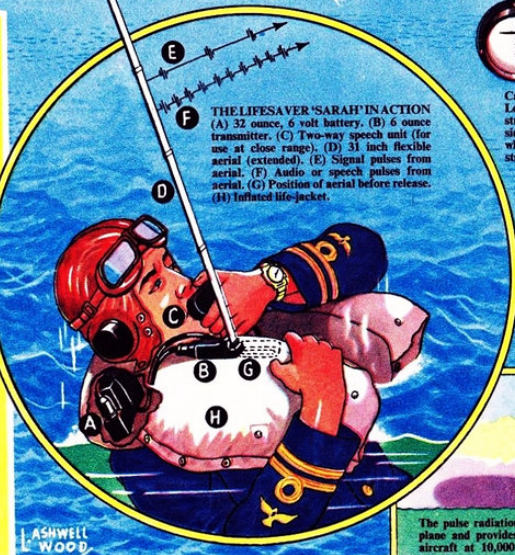
'Sarah' - short for Search And Rescue And Homing - is a new radio device for saving airmen who have come down in the sea.

A radio transmitter, weighing only 6 ounces, with a 32 ounce, 6 volt battery, is fitted to the survivor's life-jacket and transmits a signal to guide searching aircraft. The stranded man pulls a ring which releases a 31 inch flexible aerial and starts the transmitter.

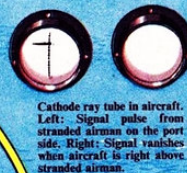
Transmission can be maintained for 20 hours with a maximum range of 66 miles to an aircraft at 10,000 feet. A distress signal at sea can thus be picked up by an aircraft within an area of 10,000 square miles.

A two-way speech unit provides means of speaking communication between rescuer and survivor when the range is very close. The signals from the transmitter are displayed on a cathode ray tube in the rescuing aircraft, which flies back and forth on a search course. The aircraft then 'homes' on to the signal, which suddenly vanishes when the aircraft is right above the stranded airman.

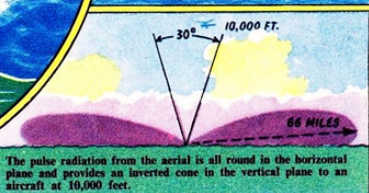
The aircraft now completes the rescue as shown here, the machine being a Westland S-51 helicopter, known in the Services as the 'Dragonfly'. The device also works in conjunction with fast surface rescue vessels. It is British designed and developed by Ultra Electric Ltd.



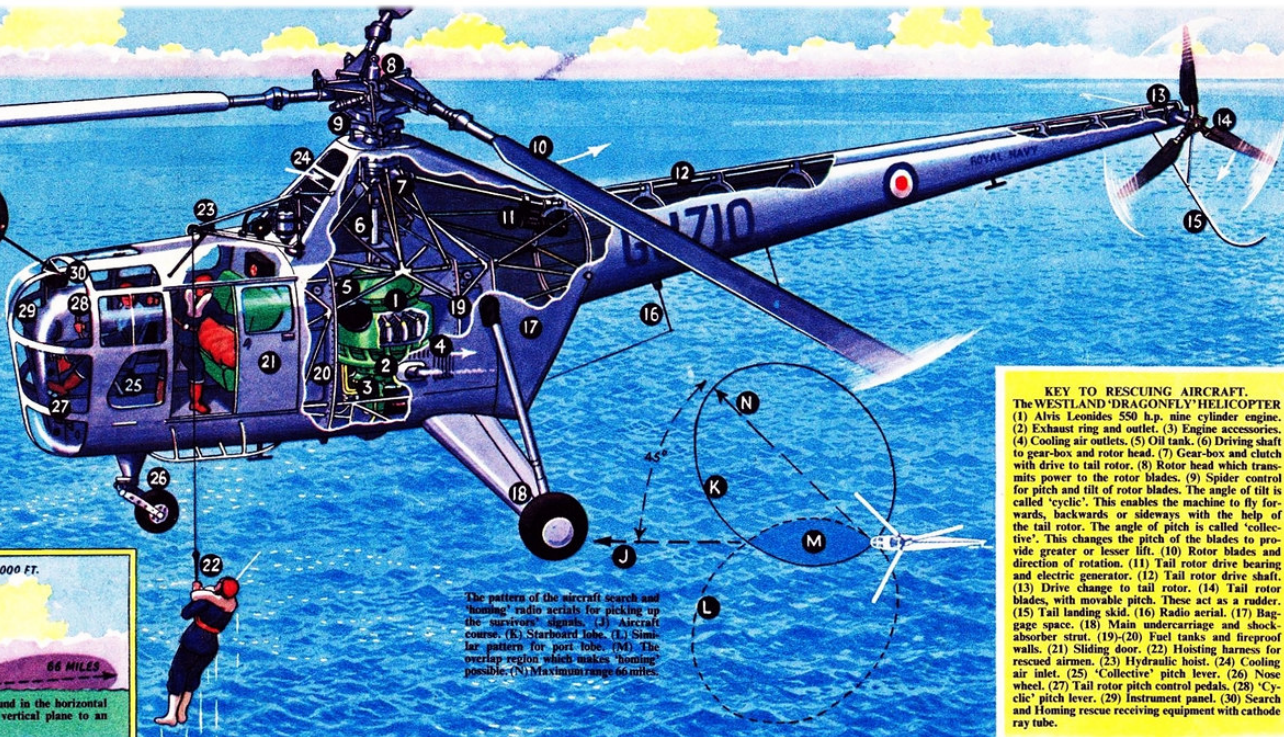
THE LIFESAVER 'SARAH' IN ACTION
(A) 32 ounce, 6 volt battery. (B) 6 ounce transmitter. (C) Two-way speech unit (for use at close range). (D) 31 inch flexible aerial (extended). (E) Signal pulses from aerial. (F) Audio or speech pulses from aerial. (G) Position of aerial before release. (H) Inflated life-jacket.



Cathode ray tube in aircraft. Left: Signal pulse from stranded airman on the port side. Right: Signal vanishes when aircraft is right above stranded airman.



The pulse radiation from the aerial is all round in the horizontal plane and provides an inverted cone in the vertical plane to an aircraft at 10,000 feet.



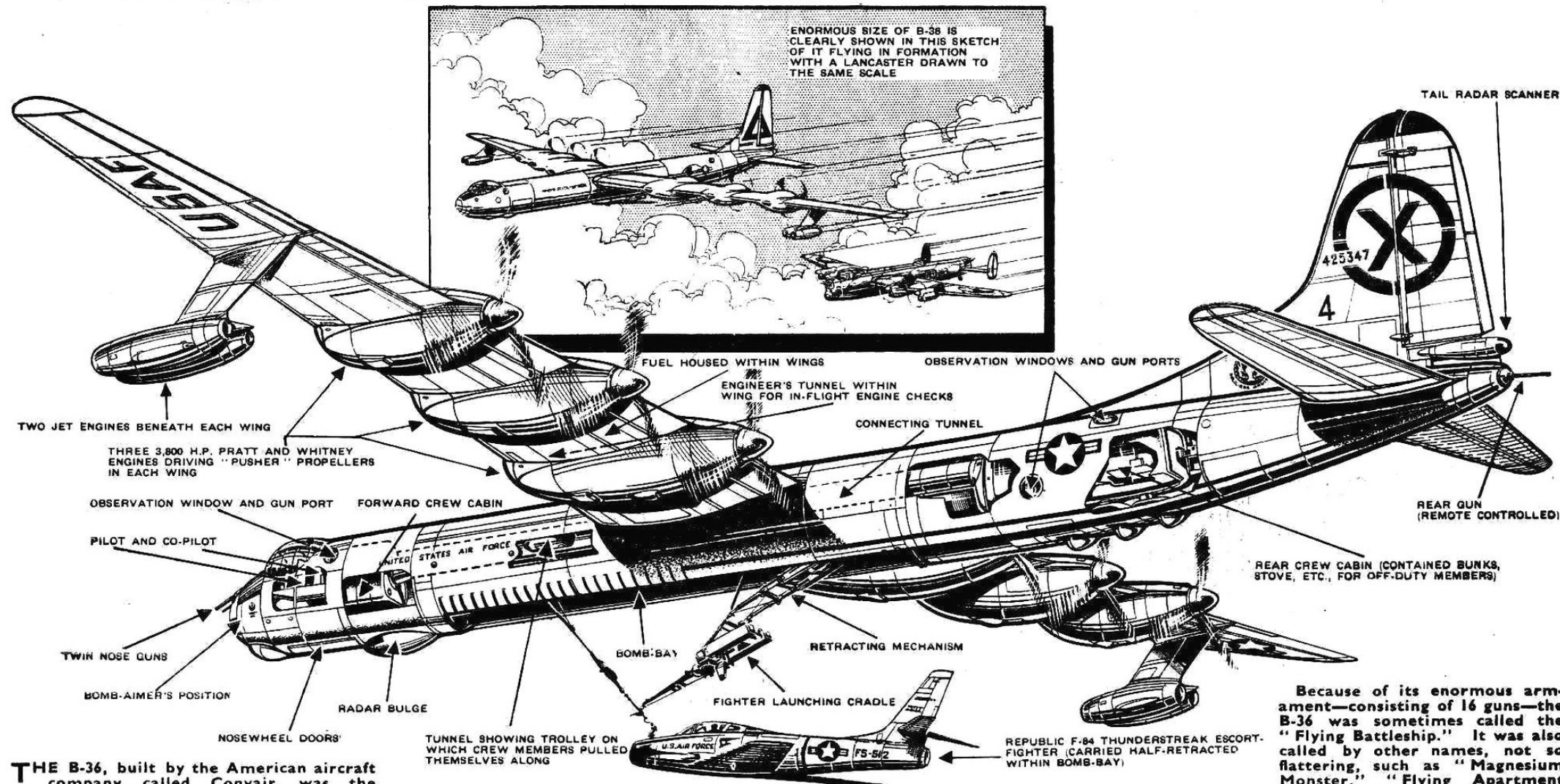
The pattern of the aircraft search and 'homing' radio aeriels for picking up the survivors' signals. (J) Aircraft course. (K) Starboard lobe. (L) Similar pattern for port lobe. (M) The overlap region which makes 'homing' possible. (N) Maximum range 66 miles.

KEY TO RESCUING AIRCRAFT.

THE WESTLAND 'DRAGONFLY' HELICOPTER
(1) Alvis Leonides 550 h.p. nine cylinder engine. (2) Exhaust ring and outlet. (3) Engine accessories. (4) Cooling air outlets. (5) Oil tank. (6) Driving shaft to gear-box and rotor head. (7) Gear-box and clutch with drive to tail rotor. (8) Rotor head which transmits power to the rotor blades. (9) Spider control for pitch and tilt of rotor blades. The angle of tilt is called 'cyclic'. This enables the machine to fly forwards, backwards or sideways with the help of the tail rotor. The angle of pitch is called 'collective'. This changes the pitch of the blades to provide greater or lesser lift. (10) Rotor blades and direction of rotation. (11) Tail rotor drive bearing and electric generator. (12) Tail rotor drive shaft. (13) Drive change to tail rotor. (14) Tail rotor blades, with movable pitch. These act as a rudder. (15) Tail landing skid. (16) Radio aerial. (17) Baggage space. (18) Main undercarriage and shock-absorber strut. (19-20) Fuel tanks and fireproof walls. (21) Sliding door. (22) Hoisting harness for rescued airmen. (23) Hydraulic hoist. (24) Cooling air inlet. (25) 'Collective' pitch lever. (26) Nose wheel. (27) Tail rotor pitch control pedals. (28) 'Cyclic' pitch lever. (29) Instrument panel. (30) Search and Homing rescue receiving equipment with cathode ray tube.

CONVAIR B-36

A BOMBER THAT CARRIED ITS OWN FIGHTER-PLANE



THE B-36, built by the American aircraft company called Convaair, was the biggest bomber in the world. But it never went into action during its eight years of life.

In the middle of 1941, when things were looking black for the Allies in the Second World War, the US Air Force asked for a bomber with a range of 10,000 miles, a ceiling of 35,000 ft., a payload of 10,000 lb., and a cruising speed of between 240 and 300 m.p.h. Although these requirements were considered fantastic in those days, a design was approved. After the atom bomb had been invented, this bomber was thought to be the ideal one to carry it.

Production went ahead, and in August 1946 the first B-36 was launched. This giant aircraft had a wing-span of 230 ft.; it was 163 ft. long, and its wings were 7½ ft. thick at their deepest point. It was powered by six 3,800 h.p. Pratt and Whitney engines, driving "pusher" propellers, and later four jet engines were added, two under each wing-tip. This gave the B-36 a total of 44,000 h.p.

The bomber was so big that it could carry as much as 84,000 lb. of bombs. It could generate 160,000 watts of electricity,

and it contained 30 miles of wiring. It carried over 30,000 gallons of fuel—enough to send a motor-car round the world 18 times. And its de-icing system could have heated a hotel with 600 rooms!

The crew of the B-36 numbered 16, and the crew cabin in the tail was equipped with bunks, an electric stove and refrigerator, folding chairs and retractable tables. To get from one end of the plane to the other, the crew pulled themselves along through a tunnel on a trolley, using an overhead cable.

Because of its enormous armament—consisting of 16 guns—the B-36 was sometimes called the "Flying Battleship." It was also called by other names, not so flattering, such as "Magnesium Monster," "Flying Apartment House," "Sitting Duck," and "Billion-Dollar Blunder."

As faster jet fighters were developed, it was decided that the B-36 could do with a bodyguard to protect it, so it was fitted out with equipment to carry and launch a Thunderstreak fighter escort plane. But this extra burden slowed it down too much to be of any great benefit.

Altogether 385 B-36s were built, each one costing 3-million dollars. But it went into retirement in 1954, because so many other faster bombers were being built that it was considered out of date.

NEXT MONDAY'S LION WILL CONTAIN A FINE CUTAWAY PICTURE OF RUSSIA'S FASTEST SUPERSONIC BOMBER. DON'T MISS IT!

KEY TO NUMBERED PARTS

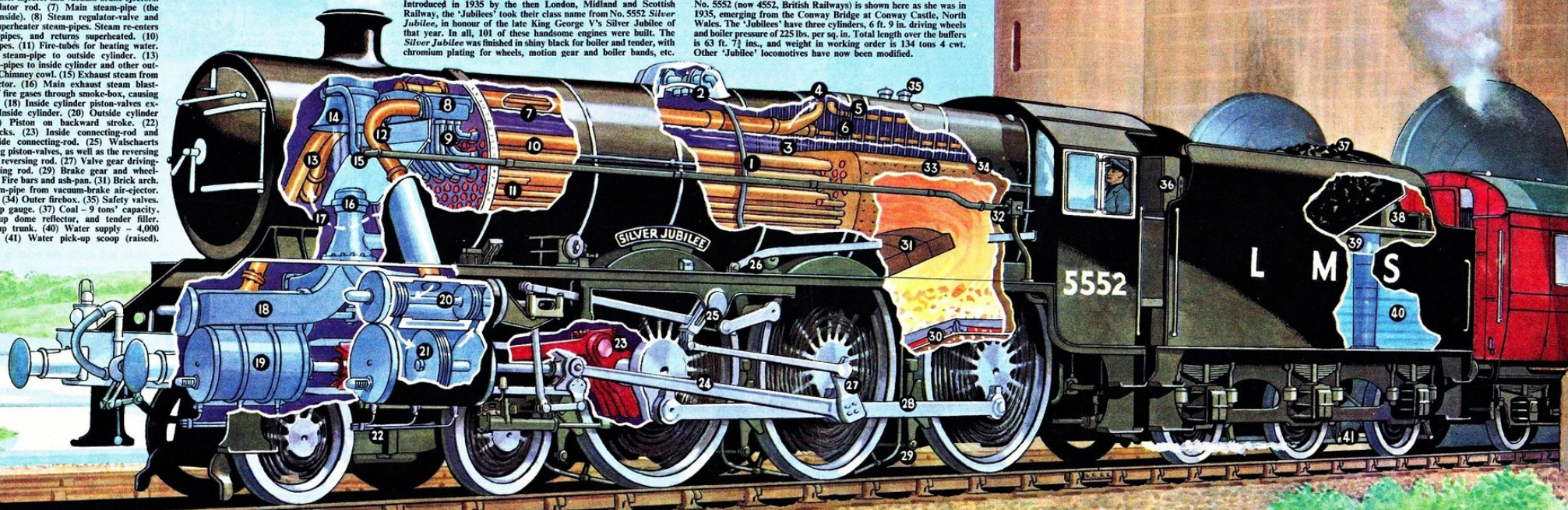
(1) Water supply from tender, via water injector. (2) Non-return water clack-valves. (3) Water level over firebox. (4) Steam entry to main steam supply-pipe. (5) Steam supply to cab for water injector and vacuum-brake ejectors. (6) Driver's regulator rod. (7) Main steam-pipe (the regulator rod is inside). (8) Steam regulator-valve and superheater. (9) Superheater steam-pipes. Steam re-enters heater inside flue pipes, and returns superheated. (10) Superheater flue pipes. (11) Fire-tubes for heating water. (12) Superheated steam-pipe to outside cylinder. (13) Superheated steam-pipes to inside cylinder and other outside cylinder. (14) Chimney cowl. (15) Exhaust steam from vacuum-brake ejector. (16) Main exhaust steam blast-pipe. (17) Path of fire gases through smoke-box, causing a vacuum therein. (18) Inside cylinder piston-valves exhaust-chest. (19) Inside cylinder. (20) Outside cylinder piston-valves. (21) Piston on backward stroke. (22) Cylinder drain-cocks. (23) Inside connecting-rod and crank. (24) Outside connecting-rod. (25) Walschaerts valve gear operating piston-valves, as well as the reversing lever. (26) Driver's reversing rod. (27) Valve gear driving-crank. (28) Coupling rod. (29) Brake gear and wheel-sanding pipes. (30) Fire bars and ash-pan. (31) Brick arch. (32) Exhaust steam-pipe from vacuum-brake air-ejector. (33) Inner firebox. (34) Outer firebox. (35) Safety valves. (36) Water pick-up gauge. (37) Coal - 9 tons' capacity. (38) Water pick-up dome reflector, and tender filler. (39) Water pick-up trunk. (40) Water supply - 4,000 gallons' capacity. (41) Water pick-up scoop (raised).

FAMOUS LOCOMOTIVE TYPES

JUBILEE CLASS 4-6-0

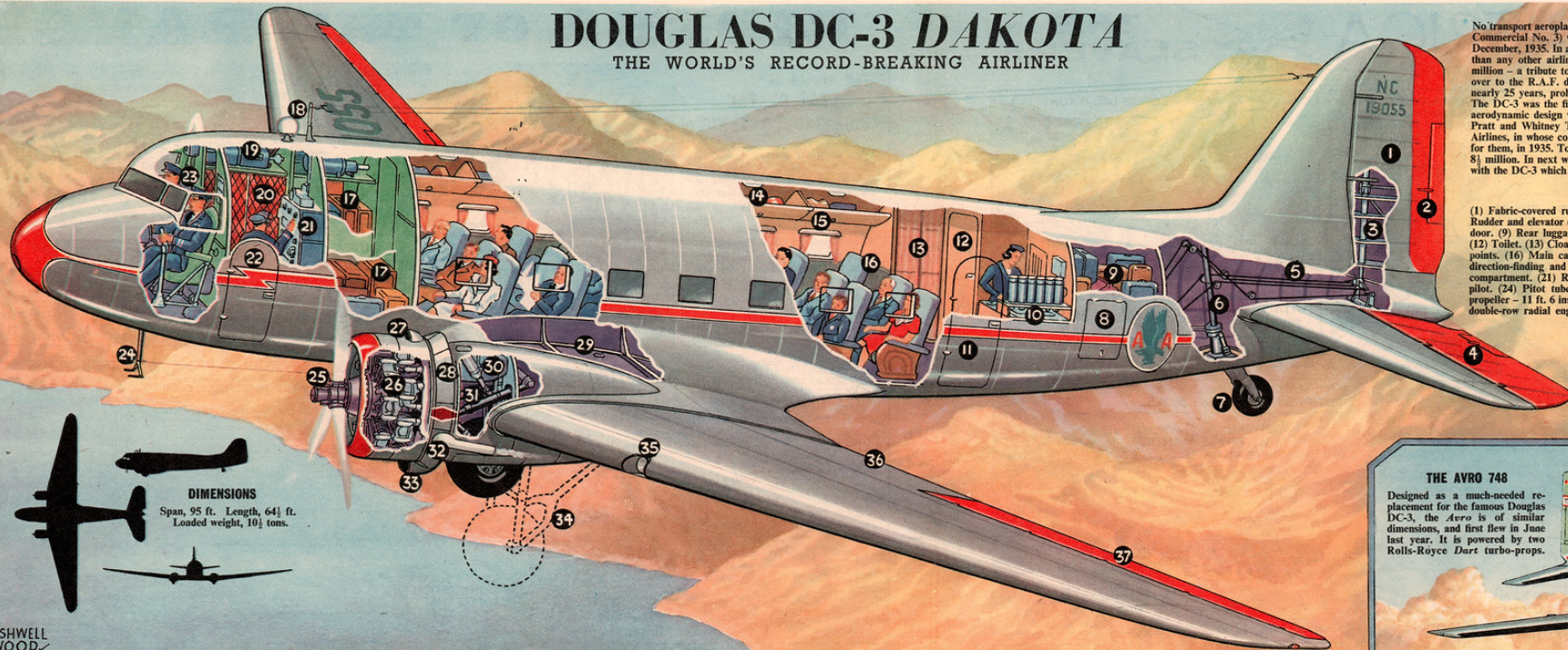
Introduced in 1935 by the then London, Midland and Scottish Railway, the 'Jubilees' took their class name from No. 5552 *Silver Jubilee*, in honour of the late King George V's Silver Jubilee of that year. In all, 101 of these handsome engines were built. The *Silver Jubilee* was finished in shiny black for boiler and tender, with chromium plating for wheels, motion gear and boiler bands, etc.

No. 5552 (now 4552, British Railways) is shown here as she was in 1935, emerging from the Conway Bridge at Conway Castle, North Wales. The 'Jubilees' have three cylinders, 6 ft. 9 in. driving wheels and boiler pressure of 225 lbs. per sq. in. Total length over the buffers is 63 ft. 7½ ins., and weight in working order is 134 tons 4 cwt. Other 'Jubilee' locomotives have now been modified.



DOUGLAS DC-3 DAKOTA

THE WORLD'S RECORD-BREAKING AIRLINER



DIMENSIONS

Span, 95 ft. Length, 64½ ft.
Loaded weight, 10½ tons.

L. ASHWELL
WOOD

No transport aeroplane has a history even remotely comparable with that of the DC-3 (Douglas Commercial No. 3) which made its first flight at Santa Monica, California, U.S.A., on 22 December, 1935. In all, some 13,000 were built – 10,926 of them in America – a number larger than any other airliner before or since. Miles flown, 7,000 million; passengers carried, 600 million – a tribute to the most successful airliner ever built. About 2,000 DC-3s were handed over to the R.A.F. during the last war, and given the name *Dakota*. In first-line service for nearly 25 years, probably about 4,000 are still flying for airlines all over the world.

The DC-3 was the first aircraft to combine a robust and durable all-metal structure of clean aerodynamic design with an effectively sound-proofed cabin. It is powered by two 1,200 h.p. Pratt and Whitney Twin-Wasp, 14-cylinder radial engines; top speed, 210 m.p.h. American Airlines, in whose colours we show the DC-3 in this drawing, were the first to place an order for them, in 1935. Today, this airline carries more passengers per year than any other – about 8½ million. In next week's issue of EAGLE, we shall feature the modern *Avro 748*, compared with the DC-3 which it is designed to replace.

KEY TO NUMBERED PARTS

(1) Fabric-covered rudder. (2) Trim tab. (3) Rudder post. (4) Fabric-covered elevators. (5) Rudder and elevator cables. (6) Tail-wheel support. (7) Castoring tail-wheel. (8) Luggage-hold door. (9) Rear luggage-hold. (10) Pantry for serving meals. (11) Passengers' entrance door. (12) Toilet. (13) Cloakroom. (14) Roof lights. (15) Hand-luggage rack, and ventilation control points. (16) Main cabin for 21 passengers. (17) Forward freight compartments. (18) Radio direction-finding and beacon aerial. (19) Water tank for central-heating system. (20) Mail compartment. (21) Radio racks. (22) Crew and forward-freight door. (23) Captain and co-pilot. (24) Pitot tube for air-speed indication. (25) Three-bladed, constant-speed Hamilton propeller – 11 ft. 6 ins. in diameter. (26) 1,200 h.p. Pratt and Whitney Twin-Wasp, 14-cylinder double-row radial engine. (27) Carburettor air-intake. (28) Engine-cooling flaps (open). (29) Petrol tanks – 680 gallons' capacity. (30) Oil tank. (31) Undercarriage retracted. (32) Exhaust outlet. (33) Oil cooler. (34) Position of undercarriage when lowered. (35) Port landing light. (36) Split flaps under trailing edge. (37) Fabric-covered port aileron.

THE AVRO 748

Designed as a much-needed replacement for the famous Douglas DC-3, the *Avro* is of similar dimensions, and first flew in June last year. It is powered by two Rolls-Royce *Dart* turbo-props.



In the centre pages of last week's issue of EAGLE, we featured the world-famous DC-3 *Dakota*; now we show, in detail, the new *Avro 748*, which is intended as a replacement. Two other competitors for this replacement are the Handley Page *Dart Herald* and the Fokker *Friendship*.

Designed as a short-haul (200 miles) feeder, or inter-city airliner, the first three *Avro 748*s are due to go into service with Skyways this summer. The *Avro* is powered by two Rolls-Royce *Dart 6* turbo-prop engines of 1,600 shaft h.p., which are mounted high over the wing; this allows space under the wing for stowing the main undercarriage. Cruising speed of the aircraft is 260 m.p.h.; seating accommodation is 40, in 10 rows of four seats, with gangway space between. We wish the *Avro 748* luck, and may it prove to be as successful as the celebrated *Dakota*.

KEY TO NUMBERED PARTS

(1) Rudder and trim tab. (2) Rudder stock. (3) Fin de-icing edge. (4) Rudder controls. (5) Elevator controls. (6) Elevator. (7) Tailplane de-icing edge. (8) Rear freight hold. (9) Freight- and emergency-door. (10) Toilet. (11) Passengers' entrance-door. (12) Rear part of 40-seater cabin. (13) Flap-operating mechanism, showing flaps down. (14) Starboard aileron. (15) Wing de-icing edge. (16) Fuel tanks; there are 570 gallons to each engine. (17) Jet exhaust. (18) Jet pipe. (19) Main undercarriage,

stowed in special nacelles. (20) Rolls-Royce *Dart 6* turbo-prop engine - 1,600 shaft h.p. (21) Compressors. (22) 12-ft. diameter propellers. (23) Forward part of 40-seater cabin. (24) Passengers' individual air-controls. (25) Roof lights, and personal-luggage rack. (26) Cabin air duct. (27) Forward freight hold. (28) Radio aerial. (29) Crew- and baggage-door. (30) Radio racks. (31) Pilot and co-pilot. (32) Steerable nose-wheel (retracted).

AVRO 748 NEW FEEDER AIRLINER

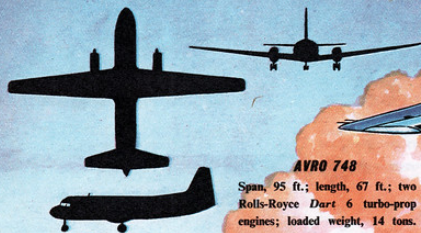


DC-3 DAKOTA

The *Avro 748* has been designed as a replacement for the DC-3 *Dakota*. Since 1935, this famous aircraft has been in first-line service for 25 years. Many are still flying all over the world.

AVRO 748

Span, 95 ft.; length, 67 ft.; two Rolls-Royce *Dart 6* turbo-prop engines; loaded weight, 14 tons.

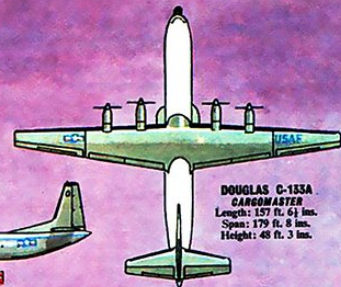


AN AIR TRANSPORT GIANT

The Douglas C-133A *Cargomaster* is the greatest load-carrying aircraft in the world. With a full cargo load of 51 tons, the maximum range is 1,330 miles; with lesser loads, the range is extended to 3,700 miles. Maximum speed is 355 m.p.h. Full fuel load is 15,051 gallons. The *Cargomaster* is a most impressive machine, and can carry any of the American ground-force vehicles, as well as the largest guided missiles or 250 fully-equipped troops. The interior floor space is 90 ft. long by 11 ft. wide. There are eight retractable main undercarriage wheels. They are housed in two sets of four, inside large bulges attached to the fuselage, port and starboard; the port bulge also holds two auxiliary jet-turbine engines. The four main engines are Pratt and Whitney T34 jet turboprops of 6,000 h.p. each.

KEY TO PARTS: (1) Search radar-aerial and dielectric radome. (2) Captain's and Co-Pilot's seats. (3) Position of Systems engineer; Navigator on port side. (4) Double skin of pressurized cabin. (5) Crew's buffet. (6) Relief-crew bunks. (7) Stairs to flight deck. (8)

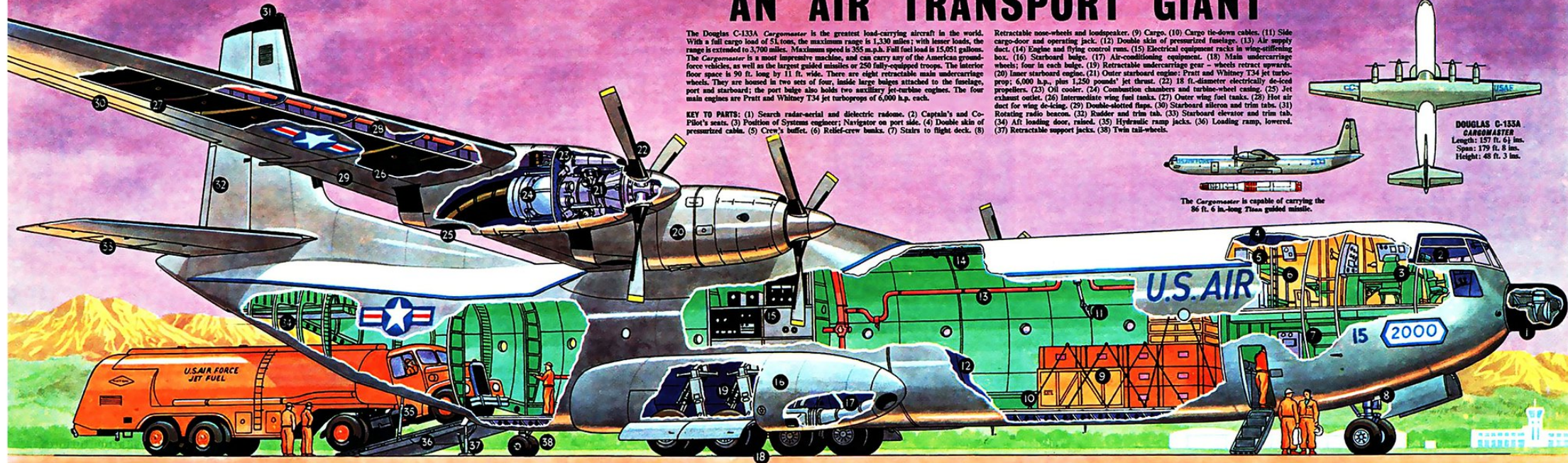
Retractable nose-wheels and loudspeaker. (9) Cargo. (10) Cargo tie-down cables. (11) Side cargo-door and operating jack. (12) Double skin of pressurized fuselage. (13) Air supply duct. (14) Engine and flying control runs. (15) Electrical equipment racks in wing-stiffening box. (16) Starboard bulge. (17) Air-conditioning equipment. (18) Main undercarriage wheels; four in each bulge. (19) Retractable undercarriage gear - wheels retract upwards. (20) Inner starboard engine. (21) Outer starboard engine: Pratt and Whitney T34 jet turboprop; 6,000 h.p., plus 1,250 pounds' jet thrust. (22) 18 ft.-diameter electrically de-iced propellers. (23) Oil cooler. (24) Combustion chambers and turbine-wheel casing. (25) Jet exhaust outlet. (26) Intermediate wing fuel tanks. (27) Outer wing fuel tanks. (28) Hot air duct for wing de-icing. (29) Double-slotted flaps. (30) Starboard aileron and trim tabs. (31) Retracting radio beacon. (32) Rudder and trim tabs. (33) Starboard elevator and trim tabs. (34) Aft loading door, raised. (35) Hydraulic ramp jacks. (36) Loading ramp, lowered. (37) Retractable support jacks. (38) Twin tail-wheels.



**DOUGLAS C-133A
CARGOMASTER**
Length: 157 ft. 6 1/2 ins.
Span: 179 ft. 8 ins.
Height: 48 ft. 3 ins.



The *Cargomaster* is capable of carrying the 56 ft. 6 in.-long *Thien* guided missile.



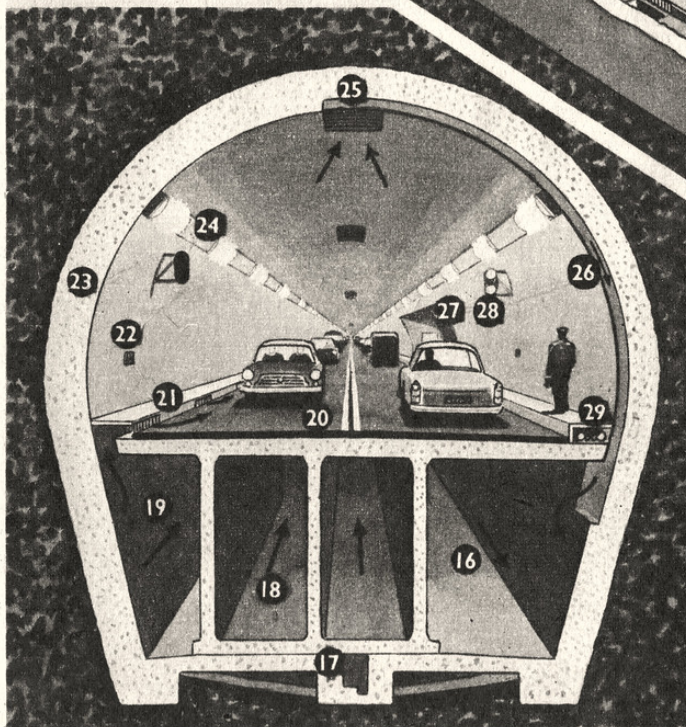
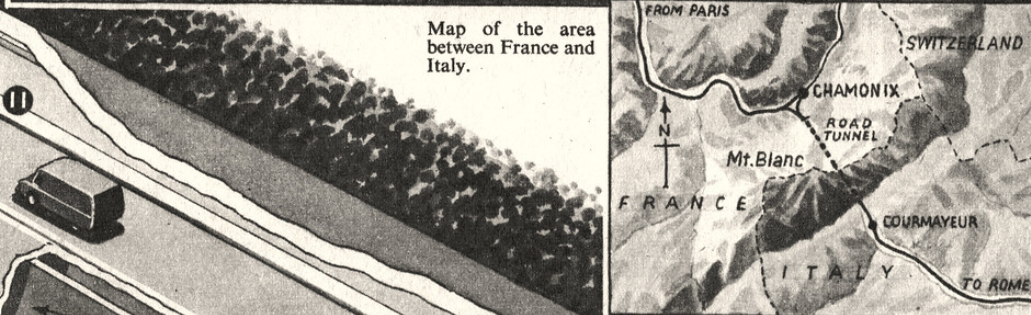
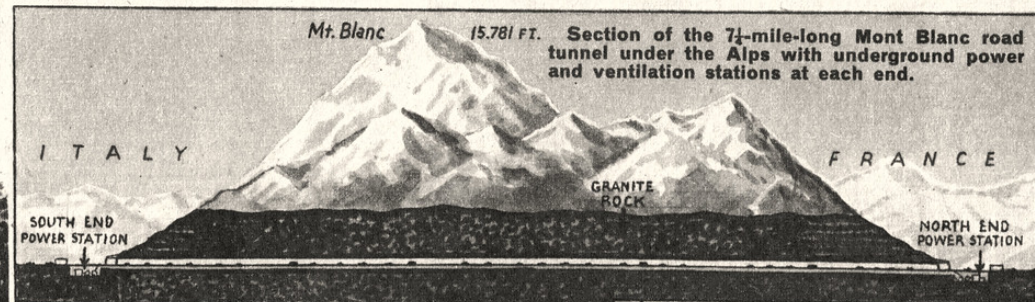
THE WORLD'S LONGEST SHORT CUT

A 7½-mile-long tunnel, the longest road tunnel in the world, has recently been driven through the heart of Europe's highest mountain, Mont Blanc. It will provide a new road link, open in all weathers, through the Alps where most of the existing passes are blocked by snow for six months of the year. Taking some 6½ years to construct, it has been called 'the world's longest short cut.' Linking France with Italy, it will reduce the distance between Paris and Rome by 174 miles.

The tunnel, 4,330 ft. above sea level, has been considered one of the greatest engineering feats of this century. The

north end is near Chamonix in France, and the south end near Courmayeur in Italy. Traffic can pass through at the rate of 450 vehicles per hour. The tunnel is horseshoe in shape and 30 ft. wide inside, above the road.

Under the road are ventilating ducts for fresh air and an exhaust duct for foul air. Underground power stations at each end supply power for lighting and ventilation fans, each station serving one-half of the tunnel. Over 2½ million tons of granite rock were excavated and ½ million tons of concrete used for lining the tunnel.



CROSS SECTION OF TUNNEL

(16) Foul air exhaust duct. (17) Drain. (18) Fresh air ducts to different parts of the tunnel. (19) Fresh air duct. (20) 24-ft. roadway. (21) Fresh air inlet vents under footpath. (22) Radar traffic counter. (23) Concrete lining, 30 in.

thick. (24) Fluorescent lighting throughout the tunnel. (25) Foul air exhaust vents. (26) Foul air vent to exhaust duct. (27) Layby. (28) Traffic lights. (29) Power and telephone cables under footpath.



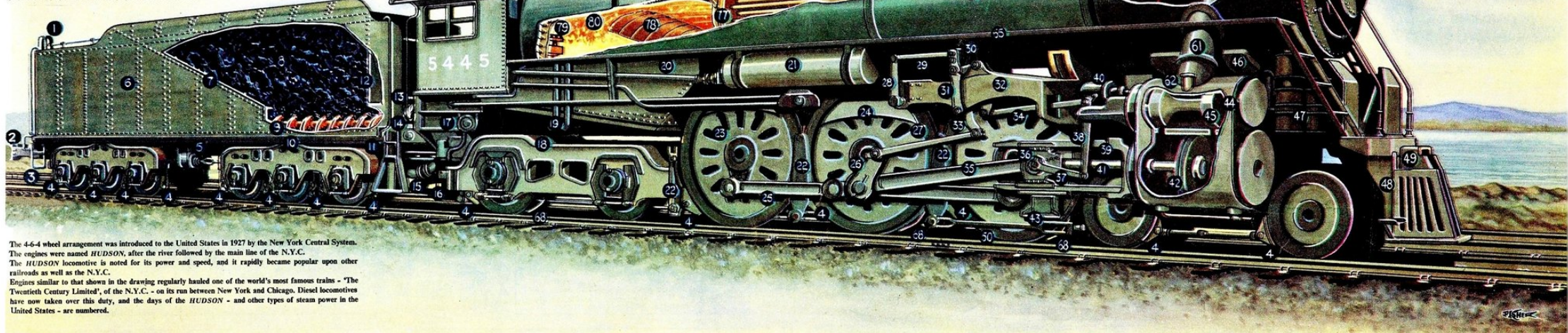
KEY TO NUMBERED PARTS

(1) Fresh air ducts from ventilation fans in power station. (2) Foul air exhaust duct to extraction fans in power house. (3) Fluorescent lighting, each side of the tunnel. (4) Foul air exhaust vents in roof. Carbon-monoxide gas from vehicle exhausts. (5) Fresh air inlet vents under footpath. (6) Fresh air ducts serving different lengths of tunnel. (7) Section through granite rock. The tunnel was drilled and excavated over 3½ miles from each end. At the breakthrough, the margin of error was only 4½ in. (8) Fresh air inlet vents. (9) 12-ft.-wide Northbound roadway. (10) 12-ft.-wide South-

bound roadway. Vehicles are equally and safely spaced and must maintain a speed of 35 m.p.h. (11) Footpath. (12) Layby with telephone (every 300 yards) for breakdown or emergency. (13) Signals for regulating traffic density and spacing. (14) Concrete lining. (15) Foul air exhaust vent.

AN AMERICAN 4-6-4 HUDSON STEAM LOCOMOTIVE

KEY TO NUMBERED PARTS: (1) End ladder. (2) Tender coupler. (3) Tender rear step. (4) Brake shoe. (5) Tender brake cylinder. (6) Water tank; capacity, 12,500 gallons. (7) Tender slope sheet. This 'gravity feeds' coal on to conveyor-screw. (8) Fuel space; capacity, 24 tons. (9) Conveyor-screw to Stoker. (10) The tender is borne on two six-wheel bogie-trucks. (11) Tender gangway step. (12) Coal gate. (13) Cab apron. (14) Stoker intermediate conveyor. (15) Tank water hose. (16) Booster engine, providing auxiliary power by driving rear wheels of trailing bogie. (17) Equalizing reservoir. (18) Trailing bogie-truck frame. (19) Suction pipe and injector overflow pipe. (20) Power reverse operating shaft. (21) Main air reservoir. (22) Brake hanger. (23) Scullin 79-inch diameter driving wheels. (24) Counterbalance. (25) Coupling rods. (26) Eccentric crank. (27) Eccentric rod. (28) Reverse shaft arm. (29) Valve gear reach rod. (30) Bell crank. (31) Radius bar. (32) Valve gear frame. (33) Valve gear arm. (34) Valve rod. (35) Main connecting rod. (36) Crosshead. (37) Union link. (38) Combination lever. (39) Crosshead guide. (40) Driving wheel brake cylinder. (41) Piston rod. (42) Piston. (43) Crosshead step. (44) Valve chamber. (45) Piston valve. (46) Cylinder saddle. (47) Air-compressor pumps. (48) Commonwealth drop-coupler pilot. (49) Drop-coupler housing. (50) Brake pull rod. (51) Smoke-box. (52) Smokebox door. (53) Headlight and support. (54) Feedwater heater. This uses the latent heat of the exhaust to heat up the water, which is then forced into the boiler by a pump. (55) Booster Exhaust stack. (56) Smokestack. (57) Smokestack extension. (58) Bell; rung by air pressure. (59) Superheater header. (60) Superheater tubes. (61) Steam pipe to cylinders. (62) Steam chest relief valve. (63) Front tubesheet. (64) Dry pipe; conducts steam to valve and cylinders. (65) Running-board. (66) Boiler check valve. (67) Sand dome. (68) Sand pipe outlet. (69) Dotted line indicates water-level in boiler and over firebox. (70) Steam dryer. (71) Turret supply steam dryer. (72) Turret dry pipe. (73) Fire tubes. (74) Safety valve. (75) Whistle. (76) Firebox stays. (77) Back tubesheet. (78) Brick arch. (79) Stoker ejector mouthpiece. (80) Firebox. (81) Turret. (82) Cab ventilator. (83) Cab smoke-deflector.



The 4-6-4 wheel arrangement was introduced to the United States in 1927 by the New York Central System. The engines were named HUDSON, after the river followed by the main line of the N.Y.C. The HUDSON locomotive is noted for its power and speed, and it rapidly became popular upon other railroads as well as the N.Y.C. Engines similar to that shown in the drawing regularly hauled one of the world's most famous trains - 'The Twentieth Century Limited', of the N.Y.C. - on its run between New York and Chicago. Diesel locomotives have now taken over this duty, and the days of the HUDSON - and other types of steam power in the United States - are numbered.

THE CHANNEL TUNNEL

The Channel tunnel has been one of the most talked about topics for many years - in fact Napoleon talked about it! A great deal of preliminary work has been done on both sides of the Channel, companies have been formed, eminent engineers, geologists, scientists and politicians have been called in as advisers, but the tunnel has never been built. Yet the idea has such an appeal to the imagination that it is by no means dead. Therefore the Channel, or to be precise the Strait of Dover, is always a challenge to people with ideas, energy and enterprise. Some swim across, some paddle across in canoes, some row across. In this drawing we show the latest ideas put forward for the tunnel's construction, but the price is staggering - today estimated at £100,000,000.

KEY TO THE PROPOSED TUNNEL

(1) Railway entrance from Folkestone. (2) Twin railway tunnels to main tunnel. (3)-(3) Ventilating ducts. (4)-(4) Ventilating stations. (5) Road tunnel to Dover. (6) Drainage uptake. (7) Pumping station. (8) Existing railway tunnel through Shakespeare cliff to Dover. (9) Drainage tunnels. (10) Main tunnel carrying road traffic and two electric railway tracks. (11) Thickness of chalk above middle of tunnel. (12) Drainage tunnels, French side. (13) Pumping station. (14) Ventilating stations. (15) Railway tunnel curves away to join up with the French system at Marquise.

KEY TO GEOLOGICAL FEATURES

(A) Section of Channel at the Strait of Dover. (B) Chalk bed pervious to water. (C) Strata of grey chalk, impervious to water, in which the tunnel would be bored. (D) Strata of gault, a blue clay impervious to water. (E) Bed of lower greens and pervious to water. (F) Strata of Jurassic rock.

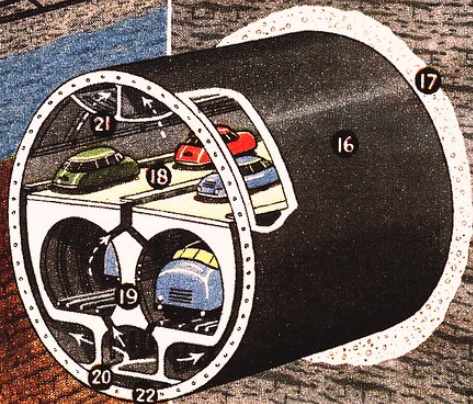
STRAIT OF DOVER

CALAIS

CAP GRIS-NEZ

KEY TO MAIN TUNNEL

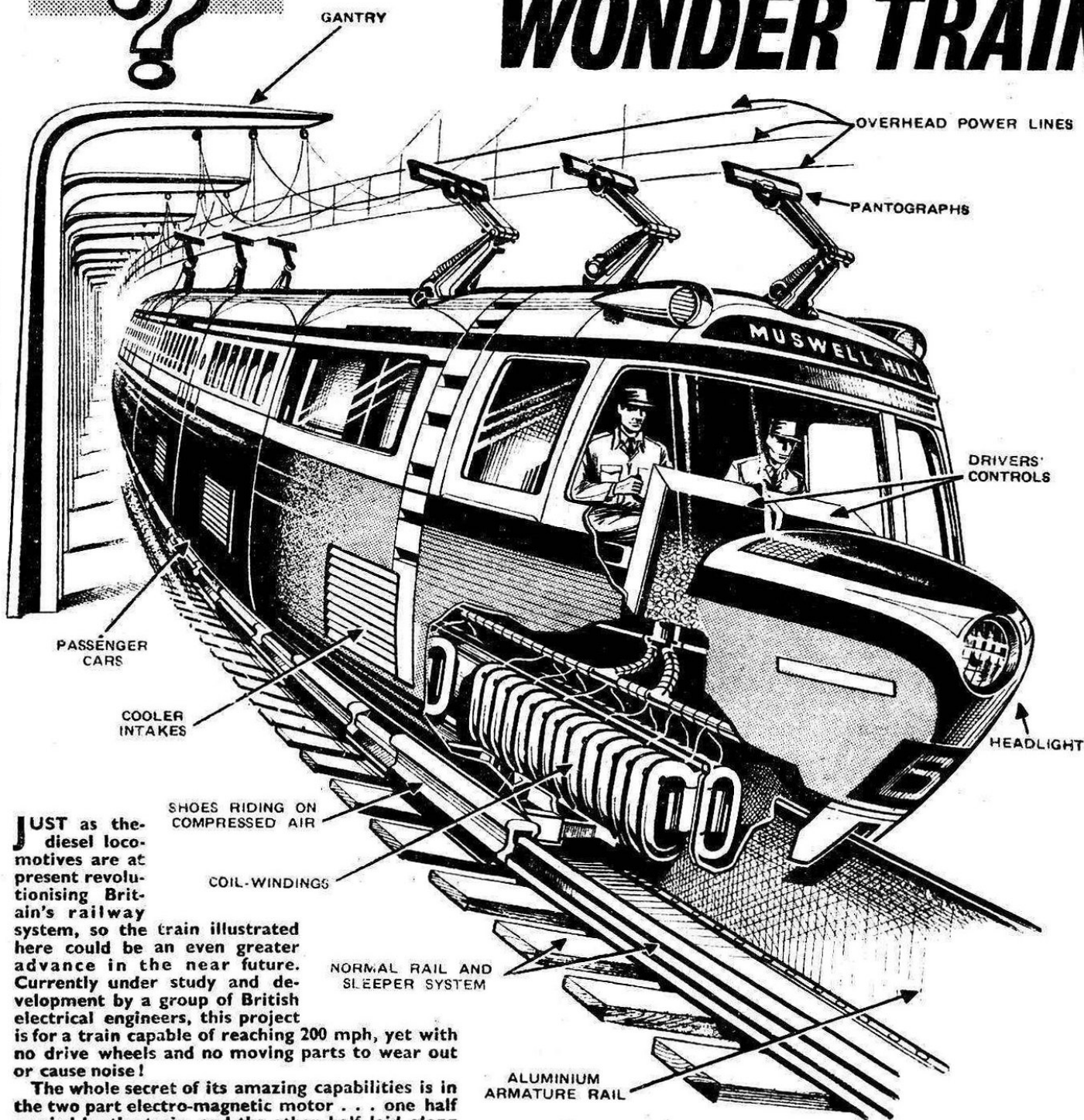
(16) Egg-shaped steel tunnel built up in sections, 65 feet deep and 42 feet wide.
(17) Concrete grouting in chalk bed.
(18) Double traffic roads.
(19) Twin electric railway tracks.
(20) Ventilating air intake.
(21) Used air extracting duct.
(22) Drainage well.



ASHWELL
WOOD

WHAT'S NEW ?

BRITAIN'S 200 M.P.H. WONDER TRAIN



JUST as the diesel locomotives are at present revolutionising Britain's railway system, so the train illustrated here could be an even greater advance in the near future. Currently under study and development by a group of British electrical engineers, this project is for a train capable of reaching 200 mph, yet with no drive wheels and no moving parts to wear out or cause noise!

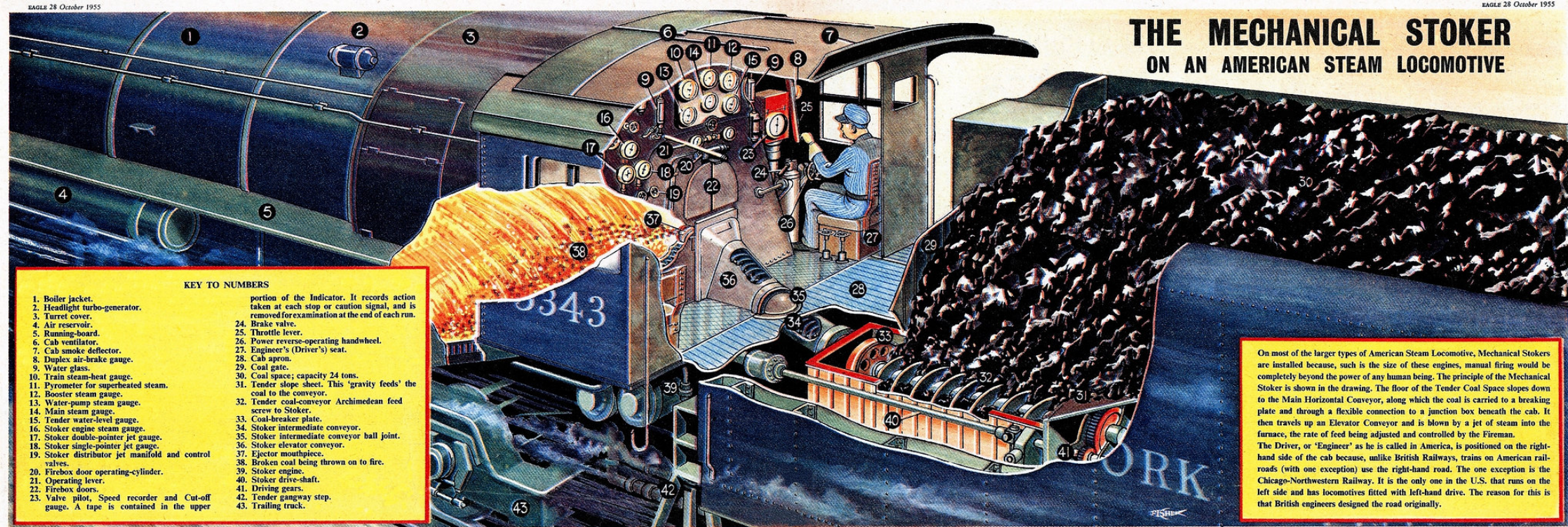
The whole secret of its amazing capabilities is in the two part electro-magnetic motor . . . one half carried by the train, and the other half laid along the track! As seen in the drawing, a continuous aluminium strip is laid upright between the rails along the length of the track. This strip plays the part of the armature, along which the train pulls itself by means of a moving magnetic field, provided by power from the overhead grid.

As the locomotive only carries half the motor, and does not require friction between wheels and rails to provide forward

motion, it can be of extremely lightweight construction. At the high speeds attainable, wheels would cause a lot of trouble, and the designers are working on ideas for a wheel-less, air-supported train. Jets of compressed air forced out of special rail-fitting shoes would lift the carriages a fraction of an inch off the rails. The train could then glide along safely at any speed on the thin layer of air.

WHAT'S NEW NEXT WEEK? — THE AIRCRAFT CARRIER OF THE FUTURE!

THE MECHANICAL STOKER ON AN AMERICAN STEAM LOCOMOTIVE



KEY TO NUMBERS

- | | |
|---|--|
| 1. Boiler jacket. | 24. Brake valve. |
| 2. Headlight turbo-generator. | 25. Throttle lever. |
| 3. Turret cover. | 26. Power reverse-operating handwheel. |
| 4. Air reservoir. | 27. Engineer's (Driver's) seat. |
| 5. Running-board. | 28. Cab apron. |
| 6. Cab ventilator. | 29. Coal gate. |
| 7. Cab smoke deflector. | 30. Coal space; capacity 24 tons. |
| 8. Duplex air-brake gauge. | 31. Tender slope sheet. This 'gravity feeds' the coal to the conveyor. |
| 9. Water glass. | 32. Tender coal-conveyor Archimedeian feed screw to Stoker. |
| 10. Train steam-gauge. | 33. Coal-breaker plate. |
| 11. Pyrometer for superheated steam. | 34. Stoker intermediate conveyor. |
| 12. Booster steam gauge. | 35. Stoker intermediate conveyor ball joint. |
| 13. Water-pump steam gauge. | 36. Stoker elevator conveyor. |
| 14. Main steam gauge. | 37. Ejector mouthpiece. |
| 15. Tender water-level gauge. | 38. Broken coal being thrown on to fire. |
| 16. Stoker engine steam gauge. | 39. Stoker engine. |
| 17. Stoker double-pointer jet gauge. | 40. Stoker drive-shaft. |
| 18. Stoker single-pointer jet gauge. | 41. Driving gears. |
| 19. Stoker distributor jet manifold and control valves. | 42. Tender gangway step. |
| 20. Firebox door operating-cylinder. | 43. Trailing truck. |
| 21. Operating lever. | |
| 22. Firebox doors. | |
| 23. Valve pilot, Speed recorder and Cut-off gauge. A tape is contained in the upper | |

On most of the larger types of American Steam Locomotive, Mechanical Stokers are installed because, such is the size of these engines, manual firing would be completely beyond the power of any human being. The principle of the Mechanical Stoker is shown in the drawing. The floor of the Tender Coal Space slopes down to the Main Horizontal Conveyor, along which the coal is carried to a breaking plate and through a flexible connection to a junction box beneath the cab. It then travels up an Elevator Conveyor and is blown by a jet of steam into the furnace, the rate of feed being adjusted and controlled by the Fireman.

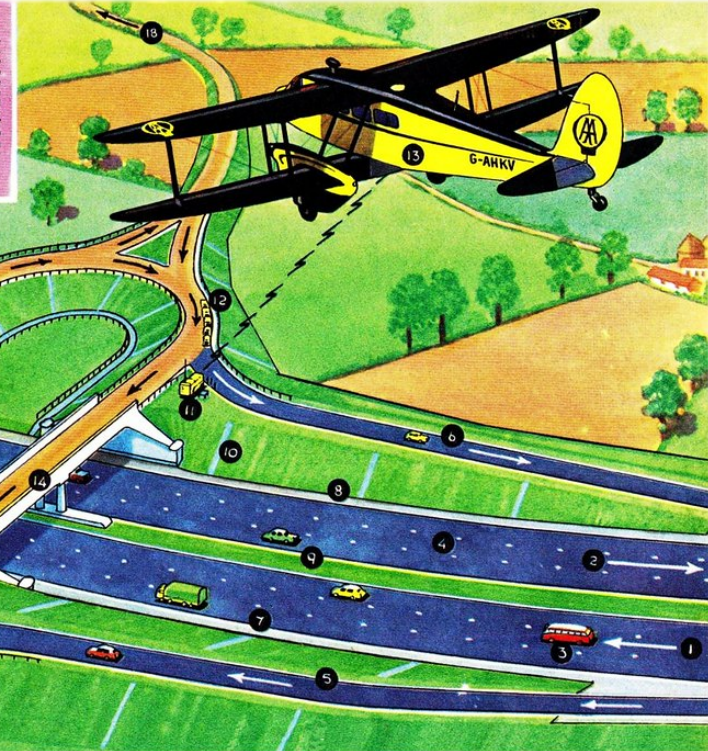
The Driver, or 'Engineer' as he is called in America, is positioned on the right-hand side of the cab because, unlike British Railways, trains on American railroads (with one exception) use the right-hand road. The one exception is the Chicago-Northwestern Railway. It is the only one in the U.S. that runs on the left side and has locomotives fitted with left-hand drive. The reason for this is that British engineers designed the road originally.

MOTORWAY ONE

Britain's first 75 m.p.h. Motorway, the London-Birmingham M.1., as it is called, marks the start of the motorway age. The 72-mile road - the main sections of which have two 36ft.-wide carriage ways - starts in the South, near St. Albans, and runs to Dunchurch, near Rugby, in the Midlands. There, the improved A.45 road runs for 25 miles to Birmingham. A future extension will run to Doncaster, in Yorkshire. There are no crossroads or traffic lights but, instead, there are ten 'fly-over' crossings with Motorway access roads; one of these, at Broughton, Bucks., is shown in detail in the large drawing. The bulldozers and excavators have shifted 13,000,000 cubic yards of earth, and 150 bridges have been constructed. The 148 emergency telephones, placed at mile intervals, are connected direct with local police-stations, for free use in cases of breakdowns, etc. Learner-drivers, motor-cycles under 50 c.c., scooters, bicycles, invalid carriages, pedestrians and animals are banned. In next week's issue of Eagle, our technical artist will show, in

detail, one of the new 70 m.p.h. Motorway Express Coaches run by the Midland Red Co.

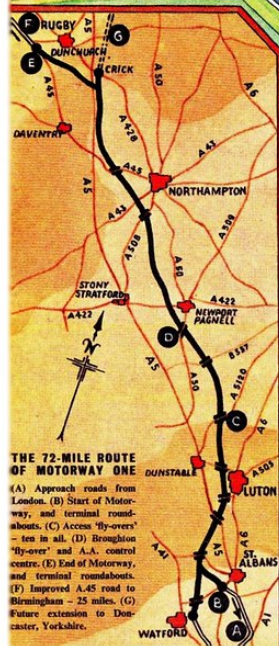
KEY TO NUMBERED PARTS: (1) From London to Birmingham. (2) To London from Birmingham. (3) New 70 m.p.h. Motorway Express Coach service to Birmingham. (4) Markings to divide the three traffic lanes in each carriage way, illuminated at night by 'cats eyes'. The fast lanes are on either side of the centre reserve strip. (5) Filter road from Motorway to 'fly-over' crossing. (6) Filter road to Motorway. (7)-(8) Hard shoulders for pulling off the Motorway, in case of breakdown. (9) Centre reserve strip; this and the side shoulders are flush with the Motorway - no kerbs. (10) Drainage ramps. (11) A.A. mobile radio-control centre. (12) A.A. patrol cars. (13) A.A. De Havilland Rapide spotting aircraft, in constant touch by radio with control centre. (14) Standard-type 'fly-over' bridges. (15) Direction of traffic flow. (16) The A.50 road from Woburn. (17) Direction of traffic flow. (18) The A.50 road to Newport Pagnell. (19) Emergency telephones - every mile. (20) Filter road from Motorway. (21) Filter road to Motorway. (22)-(23) Very gradual access from and to filter roads. (24) Ordinary road bridge.



DRIVER'S VIEW: A standard minor road bridge and dimensions of the Motorway, showing the three-lane traffic. The 9ft. hard shoulders are either side, with the 15ft. centre reserve strip in the middle of the two 36ft. carriage ways.

9 FT. 36 FT. 15 FT. 36 FT. 9 FT.
105 FT.

LASHWELL WOOD



THE 72-MILE ROUTE OF MOTORWAY ONE

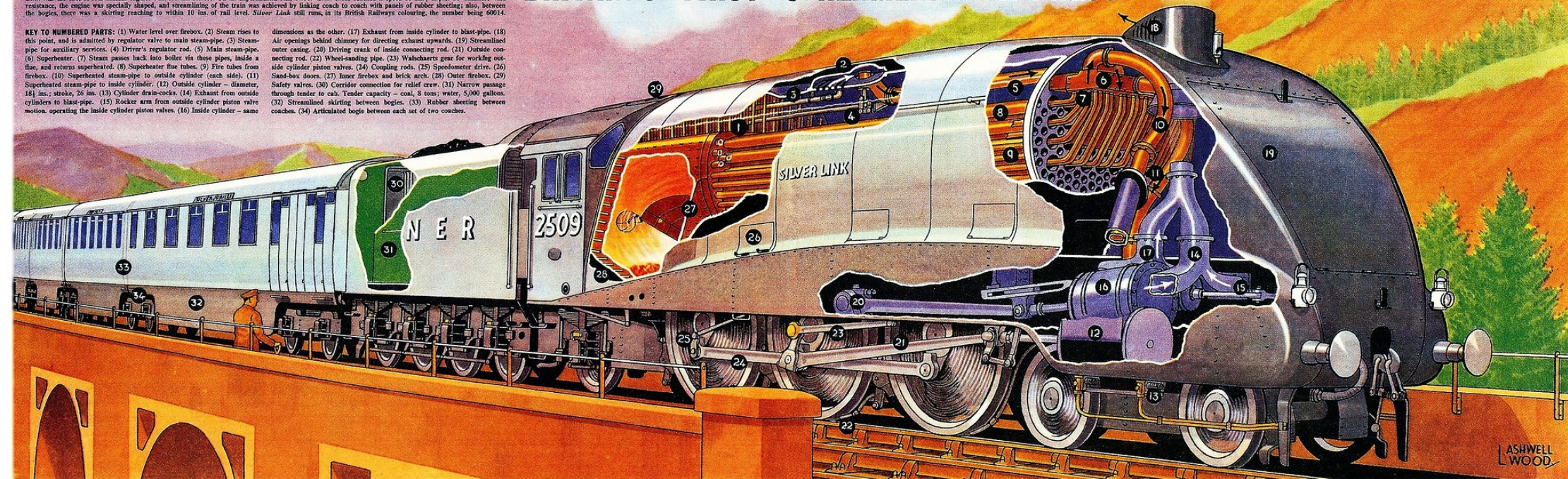
(A) Approach roads from London. (B) Start of Motorway, and terminal roundabouts. (C) Access 'fly-overs' - ten in all. (D) Broughton 'fly-over' and A.A. control centre. (E) End of Motorway, and terminal roundabouts. (F) Improved A.45 road to Birmingham - 25 miles. (G) Future extension to Doncaster, Yorkshire.

Flashback to September, 1935, when Great Britain's first fully-streamlined locomotive and train was introduced by the L.N.E.R. for working the London-Newcastle express. The *Silver Jubilee*, so named in honour of His late Majesty King George V's Silver Jubilee, was booked every day to cover the distance of 268.4 miles — with one stop at Darlington — in four hours, at an average speed of 67.1 m.p.h. The 4-6-2, three-cylinder, streamlined express locomotive *Silver Link* was the first of four similar engines built for this service. On an experimental run, *Silver Link* twice reached a speed of 112½ m.p.h. To minimize wind resistance, the engine was specially shaped, and streamlining of the train was achieved by linking coach to coach with panels of rubber sheeting; also, between the bogies, there was a skirting reaching to within 10 ins. of rail level. *Silver Link* still runs, in its British Railways colouring, the number being 60014.

KEY TO NUMBERED PARTS: (1) Water level over firebox. (2) Steam rises to this point, and is admitted by regulator valve to main steam-pipe. (3) Steam-pipe for auxiliary services. (4) Driver's regulator rod. (5) Main steam-pipe. (6) Superheater. (7) Steam passes back into boiler via these pipes, inside a flue, and returns superheated. (8) Superheater flue tubes. (9) Fire tubes from firebox. (10) Superheated steam-pipe to outside cylinder (each side). (11) Superheated steam-pipe to inside cylinder. (12) Outside cylinder — diameter, 18½ ins.; stroke, 26 ins. (13) Cylinder drain-cocks. (14) Exhaust from outside cylinders to blast-pipe. (15) Rocker arm from outside cylinder piston valve motion, operating the inside cylinder piston valves. (16) Inside cylinder — same

dimensions as the other. (17) Exhaust from inside cylinder to blast-pipe. (18) Air openings behind chimney for directing exhaust upwards. (19) Streamlined outer casing. (20) Driving crank of inside connecting rod. (21) Outside connecting rod. (22) Wheel-sanding pipe. (23) Walschaerts gear for working outside cylinder piston valves. (24) Coupling rods. (25) Speedometer drive. (26) Sand-box doors. (27) Inner firebox and brick arch. (28) Outer firebox. (29) Safety valves. (30) Corridor connection for relief crew. (31) Narrow passage through tender to cab. Tender capacity — coal, 8 tons; water, 5,000 gallons. (32) Streamlined skirting between bogies. (33) Rubber sheeting between coaches. (34) Articulated bogie between each set of two coaches.

BRITAIN'S FIRST STREAMLINED EXPRESS



H.M.S. DEFENDER

LAURENCE DUNN

The eight ships of the 'Daring' class are named *DARING*, *DAINTY*, *DECOY*, *DEFENDER*, *DELIGHT*, *DIAMOND*, *DUCHESS* and *DIANA*. Of these the *DARING* was the first to be completed - in February 1952.

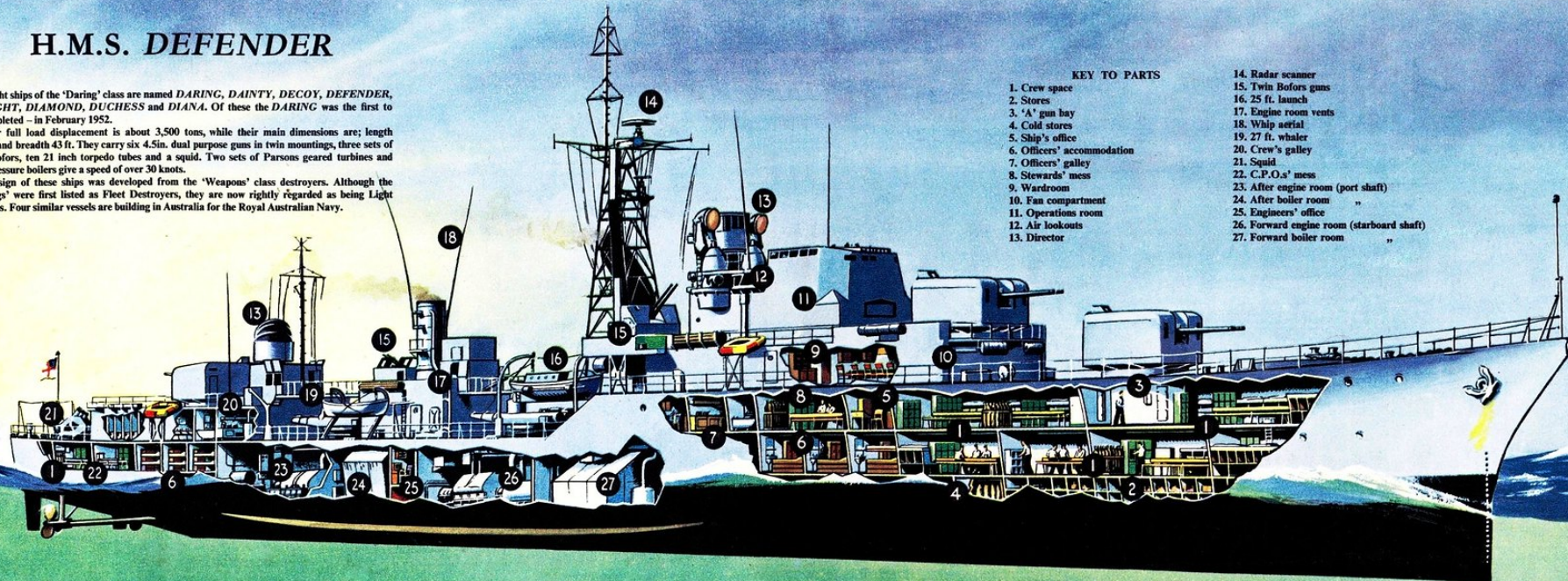
Their full load displacement is about 3,500 tons, while their main dimensions are; length 390 ft. and breadth 43 ft. They carry six 4.5in. dual purpose guns in twin mountings, three sets of twin Bofors, ten 21 inch torpedo tubes and a squid. Two sets of Parsons geared turbines and high pressure boilers give a speed of over 30 knots.

The design of these ships was developed from the 'Weapons' class destroyers. Although the 'Darings' were first listed as Fleet Destroyers, they are now rightly regarded as being Light Cruisers. Four similar vessels are building in Australia for the Royal Australian Navy.

KEY TO PARTS

1. Crew space
2. Stores
3. 'A' gun bay
4. Cold stores
5. Ship's office
6. Officers' accommodation
7. Officers' galley
8. Stewards' mess
9. Wardroom
10. Fan compartment
11. Operations room
12. Air lookouts
13. Director

14. Radar scanner
15. Twin Bofors guns
16. 25 ft. launch
17. Engine room vents
18. Whip aerial
19. 27 ft. whaler
20. Crew's galley
21. Squid
22. C.P.O.s' mess
23. After engine room (port shaft)
24. After boiler room "
25. Engineers' office
26. Forward engine room (starboard shaft)
27. Forward boiler room "



In a vessel of this type — known as a Bathyscaphe — two French naval officers have plunged to a depth of 13,284 feet under the sea! In appearance, the Bathyscaphe resembles a submarine. However, it is divided into two distinct parts. The observation chamber is fixed below the float, which is self-contained and carries a motor-generator, batteries and an air-pressure plant, as well as an ingenious system of iron-shot ballast containers and spirit tanks. Most of the float consists of tanks filled with petrol. Pipes fitted to these are open to the sea and allow free entry or exit of the water. When descending, the petrol decreases in density and water is forced into the tanks. When ascending, the pressure decreases and the water is forced out by the expansion of the spirit. Containers filled with iron-shot give the crew a means of controlling the rate of descent and also of returning to the surface. Magnetic switches, when thrown, cause the iron pellets to pour slowly out, slowing the descent. In order to ascend, more ballast is dumped until the vessel becomes lighter than the sea-water (because of the petrol) and begins to rise.

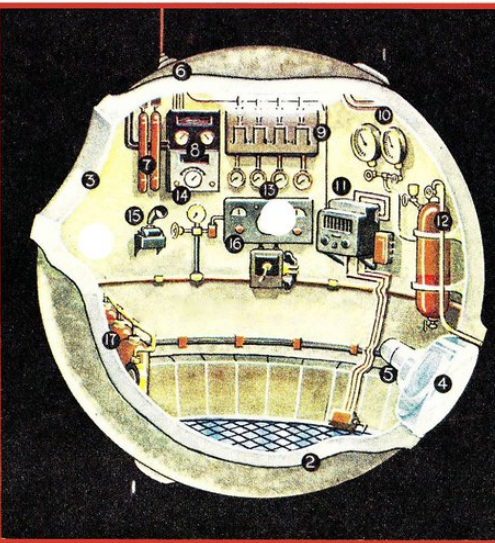
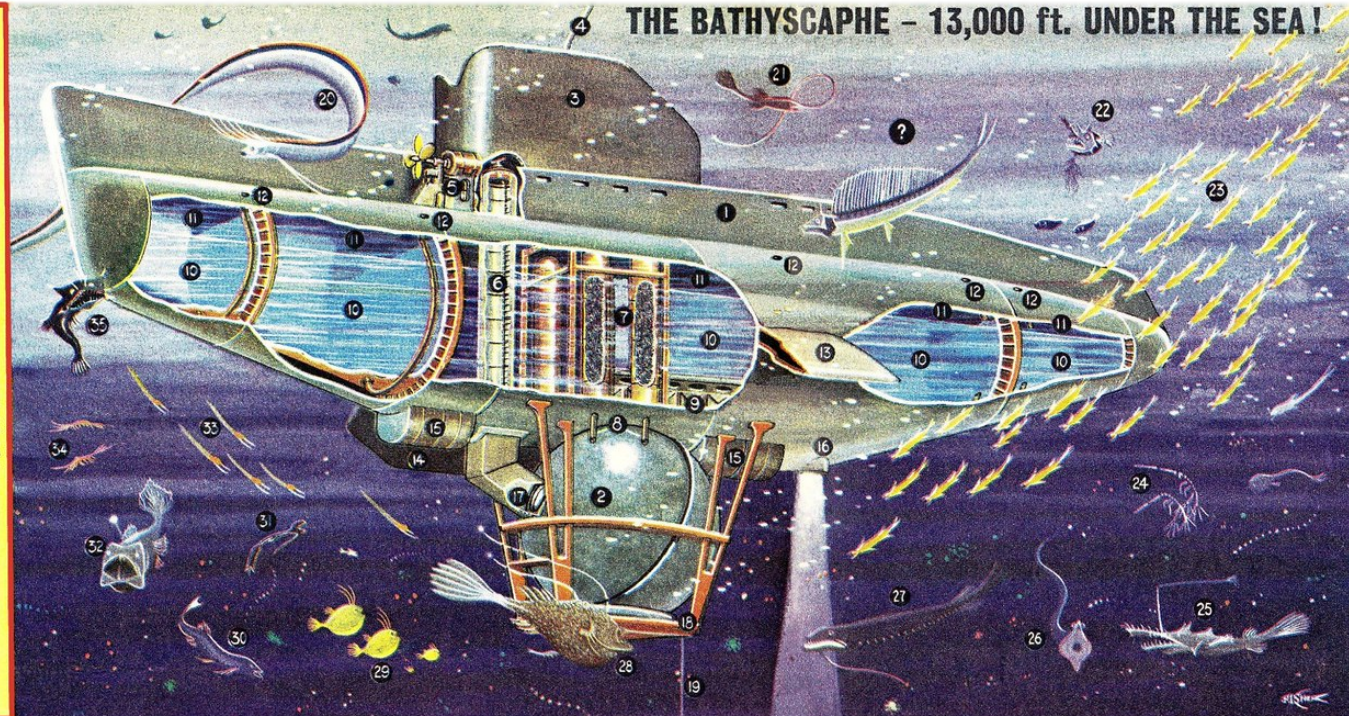
KEY TO NUMBERS

(1) Float. (2) Observation Chamber; a steel sphere designed to withstand a pressure of 5,676 pounds per square inch. (3) Conning tower. (4) Cable to marker-buoy, floating on surface and watched by patrol vessels. (5) Motor for lateral movement. Another is fitted on the starboard side. (6) Access hatch. (7) Iron-shot containers. (8) Iron-shot ejection pipes. (9) Ancillary equipment. (10) Sea-water. (11) Petrol compressed. (12) Water intake and outflow pipes. (13) Aft portion of port stabilizing fin. (14) Starboard stabilizing fin. (15) Security ballast. (16) Exterior lights. (17) Communicating trunk and entrance hatch to observation chamber. (18) Observation chamber platform. (19) Guide-rope.

Unnumerable strange, nightmare-like creatures exist far below the surface — many of them in stygian darkness, never venturing from their domain in the lowest depths of the ocean. Fishes depending upon sight carry their own lighting equipment, and the phosphorescent glow emitted by these weird creatures provided the undersea adventurers with many amazing sights.

(20) Oar-fish. Occasionally, this comes to the surface and, because of its serpent-like form, has probably been mistaken for the sea-serpent. (21) A fish with its own rod and line — the line ending in a triangle of hooks! (22) Angler-fish, with a beard! Its purpose is not known, but it is probably an organ for supplying light. (23) A school of Scarlet Arrow worms. (24) This delicate crustacean is the Needle Head. (25) Pelican-beaked Angler-fish with bristle-like teeth, mostly on the outside of its mouth! (26) Great Gulper Eel. (27) Named 'The Untouchable Bathysphere Fish', this 6-ft. giant trails its own 'traffic lights'. (28) Covered with bony spines, this female Angler-fish has her tiny husband permanently attached to her for life. He hangs beneath her body! (29) Three-starred Angler-fish. (30) Astronotus — 'Eater of Stars'. (31) Indicanthus niger. (32) The glutton with an elastic stomach! It can swallow creatures much bigger than itself! (33) Abyssal Rainbow Gars. They swim stiffly, as if they were soldiers! (34) Scarlet shrimps, capable of discharging clouds of luminous fluid to blind adversaries! (35) Black Whalet. (?) Can you supply the name of this fish? See Editor's Letter, on page 11.

THE BATHYSCAPHE — 13,000 ft. UNDER THE SEA!



THE OBSERVATION CHAMBER

(1) Clamps, sealing joints between steel hemispheres. (2) Wall of sphere; 3½ inches thick. (3) Entrance port. (4) Truncated-cone observation window made of plexiglass. (5) Special-viewing optical system. (6) Aerial. (7) Sodium carbonate, for absorbing

carbon dioxide. (8) Vertical compass. (9) Electric switches. (10) Pressure gauges. (11) Radio (transmitting and receiving). (12) Mechanism for sampling sea-water. (13) Shot gauges. (14) Temperature gauge. (15) Dictaphone. (16) Ballast control.

For observing luminous fish, complete darkness is necessary. Therefore, all lights — both interior and exterior — would be extinguished, and the dictaphone used for making notes.

A New Challenge For Steam

SEE 'HARDY'S DRAWING BOARD'—INSIDE



HARDY'S DRAWING BOARD

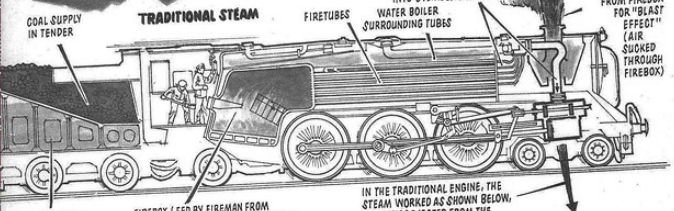
A New Challenge For Steam

MORE COAL THAN OIL IS TAKEN FROM THE GROUND EACH DAY AROUND THE WORLD. IT IS BEING "RE-DISCOVERED" AS A FUEL AND PRODUCER OF BY-PRODUCTS. MOST COAL IS USED FOR HOME HEATING OR ELECTRICITY GENERATION...



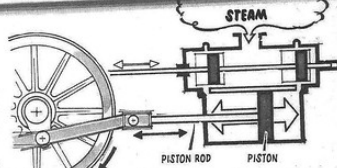
BUT SOME EXPERTS BELIEVE THAT COAL WOULD BE BETTER USED IN A NEW BREED OF STEAM LOCOMOTIVES, WHICH WOULD BE QUITE UNLIKE THEIR FAMOUS SMOKE-BREATHING ANCESTORS. IN MANY AREAS OF THE WORLD IT WOULD BE IMPOSSIBLE TO ELECTRIFY THOUSANDS OF KILOMETRES OF TRACK, AND VERY OFTEN THE SUPPLY OF WATER IS SO SMALL THAT THE LOCOMOTIVE MUST RE-USE THE SAME WATER. NOW LET'S COMPARE THE OLD LOCOMOTIVES WITH THE PROPOSED NEW ONES...

...AS FAR AS RAILWAYS ARE CONCERNED, IT IS USED FOR THE GENERATION OF ELECTRICITY (APART FROM, OF COURSE, THE REMAINING STEAM ENGINES) ALONG WITH OTHER ENERGY SOURCES.



SULPHUR DIOXIDE
SOOT
BLACK SMOKE

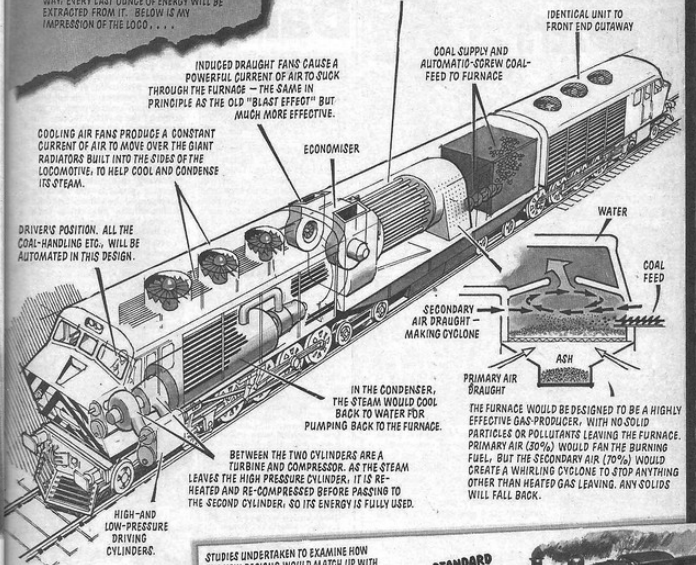
ALTHOUGH STEAM LOCOMOTIVES REACHED A HIGH PITCH OF DESIGN AND TECHNICAL COMPLEXITY, THEY DID NOT MAKE THE BEST USE OF THEIR FUEL (WHICH HAD TO BE THE BEST COAL). INCOMPLETE BURNING CAUSED THE BILLOWING OF IMPRESSIVE, BUT POLLUTING, SMOKE CLOUDS FROM THE FUNNEL. THIS WOULD BE UNACCEPTABLE TODAY.



THE BASIC WAY IN WHICH STEAM IS USED TO DRIVE THE WHEELS OF A LOCOMOTIVE IS STILL THE SAME AS IT WAS IN THE VERY BEGINNING OF STEAM ENGINES. A PISTON INSIDE A CYLINDER IS ALTERNATELY PUSHED BACKWARDS AND FORWARDS BY STEAM ADMITTED BY A MOVING VALVE SYSTEM. THE PISTON ROD TRANSMITS THE ENERGY TO THE RODS WHICH TURN THE WHEELS.

THE NEW CONDENSING STEAM LOCOMOTIVE WILL NOT RELEASE ANY SMOKE OR STEAM. IT IS DESIGNED TO MAKE THE MAXIMUM USE OF ITS WATER AND FUEL, AND IT WILL NOT BE FUSSY ABOUT THE QUALITY OF THE COAL IT BURNS. THE WATER TURNED TO STEAM WILL BE COOLED AND CONDENSED BACK INTO WATER, TO GO ROUND THE SYSTEM CONTINUOUSLY. ON THE WAY, EVERY LAST OUNCE OF ENERGY WILL BE EXTRACTED FROM IT. BELOW IS MY IMPRESSION OF THE LOCO...

TO MAKE THE BEST USE OF THE FUEL'S HEAT ENERGY, THE HEAT FROM THE GAS-PRODUCER FURNACE IS CARRIED INTO THE WATER BY AS MANY SMALL PIPES AS POSSIBLE, SO PRESENTING THE MAXIMUM HEATING AREA. THE STEAM PRODUCED IS THEN SUPERHEATED. ON ITS WAY INTO THE BOILER THE WATER PASSES THROUGH AN ECONOMISER, SET IN THE END OF THE FURNACE, TO BEGIN THE WATER'S HEATING PROGRESS.



STUDIES UNDERTAKEN TO EXAMINE HOW THE NEW DESIGNS WOULD MATCH UP WITH EXISTING TYPES SHOW THAT STEAM COULD COME BACK AND BE MORE EFFICIENT IN MANY WAYS, INCLUDING PULLING POWER, FUEL COSTS, EFFICIENT FUEL USE AND OVERALL ECONOMY. THE VARIOUS TYPES PERFORMED IN THE ORDER SHOWN.

• INCLUDING ELECTRICITY GENERATING COSTS.

STANDARD STEAM LOCOMOTIVE

DIESEL ELECTRIC

ELECTRIC

CONDENSING STEAM LOCOMOTIVE

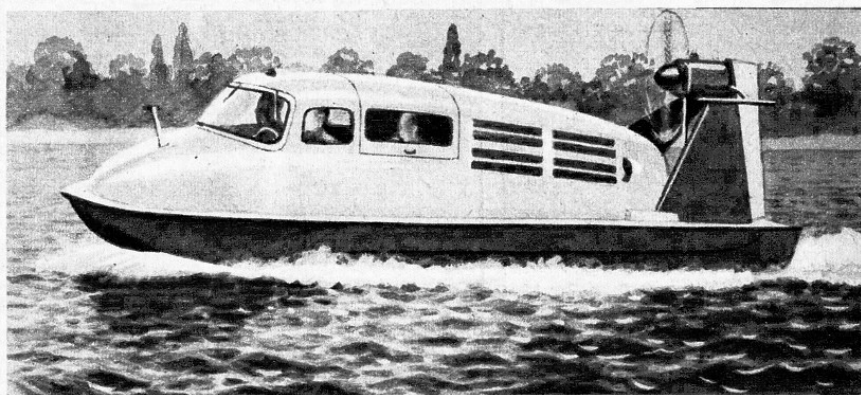


RAILWAYS AND SHIPS ARE STILL THE MOST IMPORTANT MEANS OF MOVING LARGE QUANTITIES OF FREIGHT ACROSS THE WORLD. HALF THE WORLD'S CARGO MOVES BY RAIL - SO THE PROVISION OF EFFICIENT ENGINES IS EXTREMELY IMPORTANT.

Family Mini-Hovercraft

THE *Scorpion* is a 'mini-hovercraft' amphibian designed by Robin Parkhouse to carry three adults and two children. It can be towed behind a car on a trailer. Built of glass-fibre, the craft looks like an aeroplane without wings, the cabin having 'gull wing' doors opening from the fuselage. The *Scorpion* is 20 feet long and is powered by two car engines – one provides lift, the other forward propulsion. Maximum speed – 45 m.p.h., skimming 2 inches above water or land.

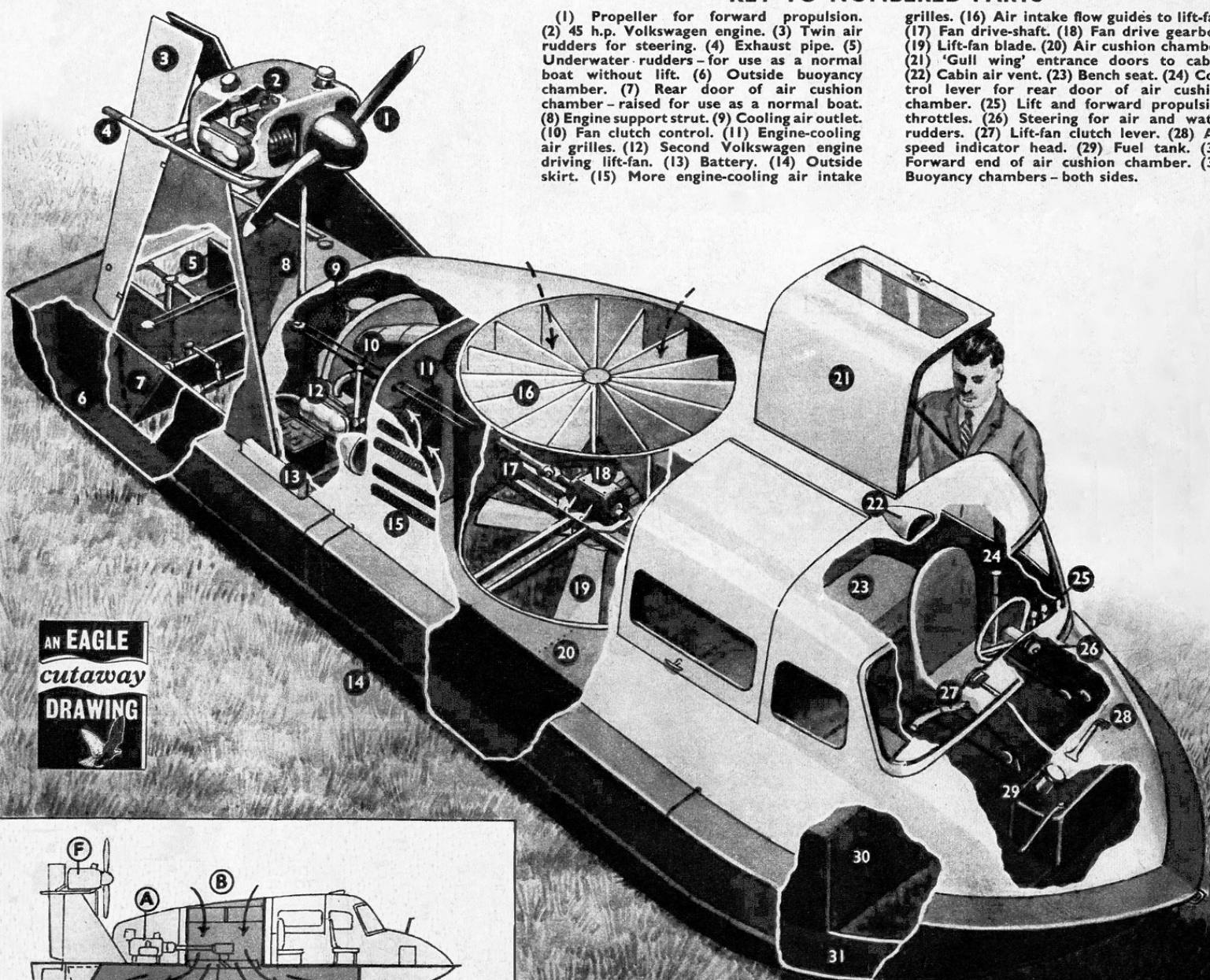
The craft uses the 'air cushion' principle to hover and can operate over water, land, ice or swamp in areas of the world where lake and river transport are the only means of communication. It is an obvious choice for transporting flying doctors, police and customs patrols, and for the family man it provides an exhilarating sport and lots of fun. Price will be about £1,500.



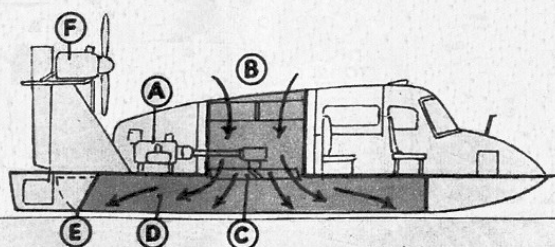
KEY TO NUMBERED PARTS

(1) Propeller for forward propulsion. (2) 45 h.p. Volkswagen engine. (3) Twin air rudders for steering. (4) Exhaust pipe. (5) Underwater rudders – for use as a normal boat without lift. (6) Outside buoyancy chamber. (7) Rear door of air cushion chamber – raised for use as a normal boat. (8) Engine support strut. (9) Cooling air outlet. (10) Fan clutch control. (11) Engine-cooling air grilles. (12) Second Volkswagen engine driving lift-fan. (13) Battery. (14) Outside skirt. (15) More engine-cooling air intake

grilles. (16) Air intake flow guides to lift-fan. (17) Fan drive-shaft. (18) Fan drive gearbox. (19) Lift-fan blade. (20) Air cushion chamber. (21) 'Gull wing' entrance doors to cabin. (22) Cabin air vent. (23) Bench seat. (24) Control lever for rear door of air cushion chamber. (25) Lift and forward propulsion throttles. (26) Steering for air and water rudders. (27) Lift-fan clutch lever. (28) Air speed indicator head. (29) Fuel tank. (30) Forward end of air cushion chamber. (31) Buoyancy chambers – both sides.



AN EAGLE
cutaway
DRAWING



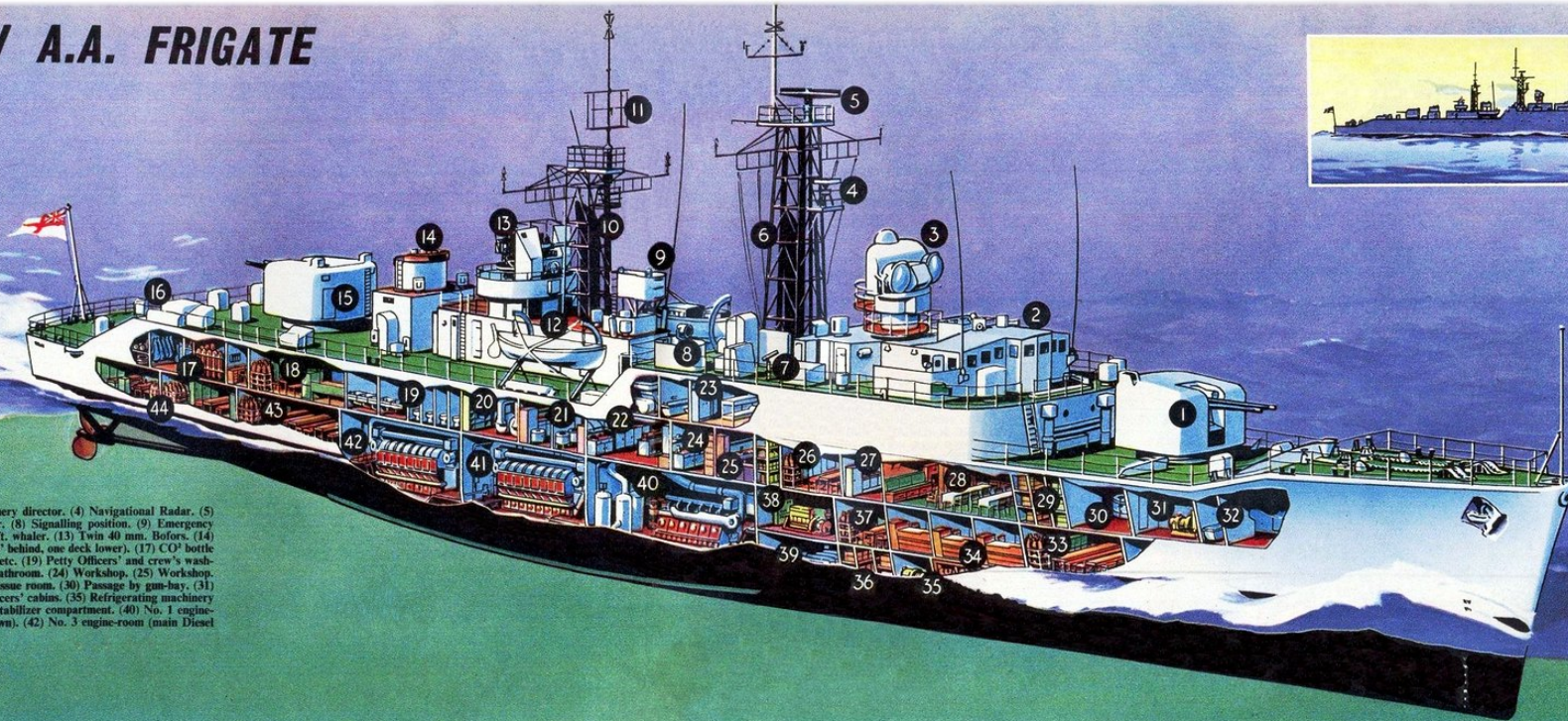
Simplified principle of lift (shaded area) and propulsion
(A) Lift engine. (B) Air intake to lift-fan. (C) Lift-fan. (D) Air cushion chamber. (E) Retractable rear door. (F) Forward propulsion engine.

LASHWELL
WOOD

H.M.S. PUMA, NEW A.A. FRIGATE

This ship is one of the *Leopard* class Frigates, designed primarily for the protection of convoys against aerial attack, but also suitable for use as small destroyers in offensive operations. As a result, this class is more heavily armed than the otherwise rather similar-looking Aircraft Defence Frigates (H.M.S. *Salisbury*, etc.) and mounts four 4.7 inch guns, two 40 mm. Bofors and a 'squad' anti-submarine mortar. Their all-welded hulls have an overall length of 340 ft. and a breadth of 40 ft. They displace approximately 1,800 tons. The main propelling machinery - spread over three engine-rooms - consists of eight Admiralty-designed, 16-cylinder Diesel engines, which drive twin screws through oil-operated gears and hydraulic couplings. The output of these engines is about 16,000 s.h.p., giving a speed of over 25 knots.

Built on the Clyde by Scotts', H.M.S. *Puma* was commissioned in the spring of 1957, a fortnight after the first of the class, H.M.S. *Lynx*. Two more, the *Leopard* and *Jaguar*, are now fitting out, while yet another, the *Brahmaputra* of the Indian Navy, has just been completed.



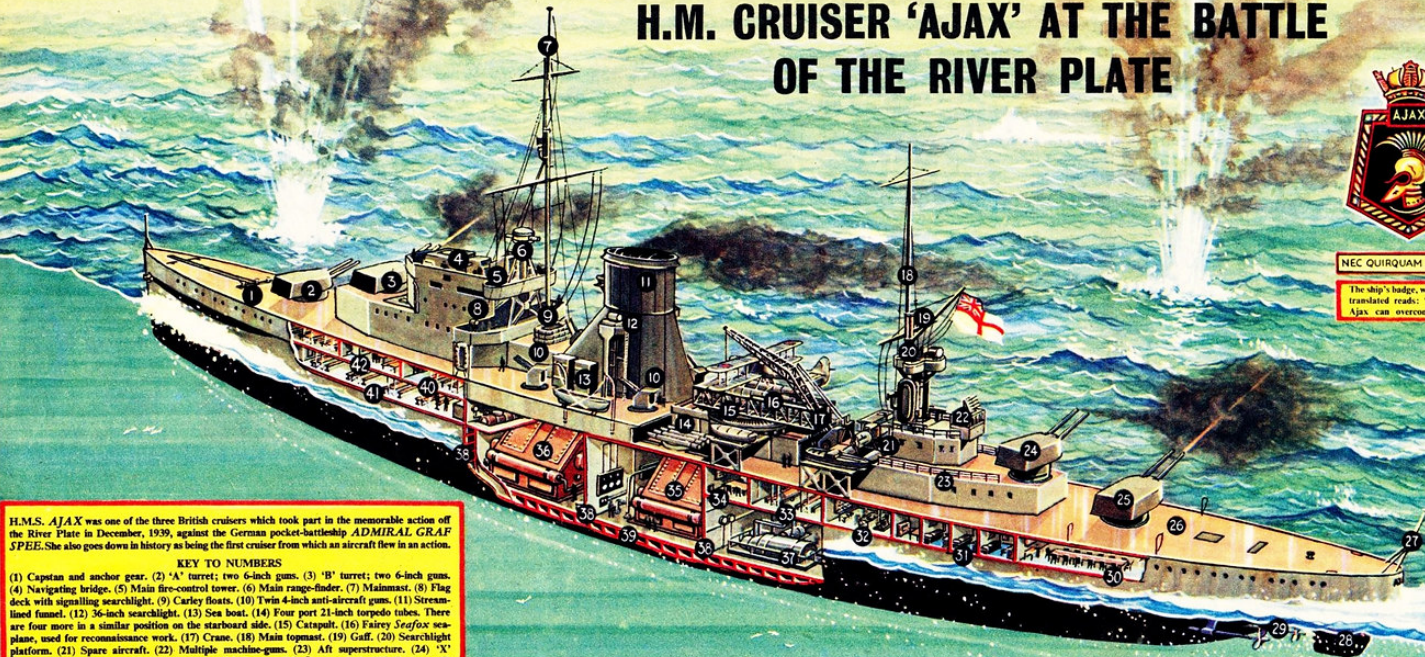
KEY TO NUMBERED PARTS: (1) 4.5 in. twin mounting. (2) Bridge. (3) Gunnery director. (4) Navigational Radar. (5) Gunnery radar. (6) Forward main engine exhaust. (7) Rocket-flare launcher. (8) Signalling position. (9) Emergency coming position. (10) After main engine exhaust. (11) Radar aerial. (12) 27 ft. whaler. (13) Twin 40 mm. Bofors. (14) Director for after armament. (15) 4.5 in. twin mounting. (16) Life-rafts ('Squid' behind, one deck lower). (17) CO's bottle store (right); oilskin locker (left). (18) Mess for Cooks, Sick-bay Attendants, etc. (19) Petty Officers' and crew's wash-places. (20) Laundry. (21) Galley (22) Workshop. (23) Sick-bay, with (left) bathroom. (24) Workshop. (25) Workshop. (26) Seamen's mess. (27) Wardroom pantry. (28) Wardroom. (29) Provision issue room. (30) Passage by gun-bay. (31) Emergency generator. (32) Seamen's washplace. (33) Seamen's mess. (34) Officers' cabins. (35) Refrigerating machinery and cold-room. (36) Store. (37) Seamen's mess. (38) Low power room. (39) Stabilizer compartment. (40) No. 1 engine-room (auxiliary generator in front). (41) No. 2 engine-room (main Diesel shown). (42) No. 3 engine-room (main Diesel shown). (43) Seamen's mess. (44) Stokers' mess.

H.M. CRUISER 'AJAX' AT THE BATTLE OF THE RIVER PLATE



NEC QUIRQUAM NISI AJAX.

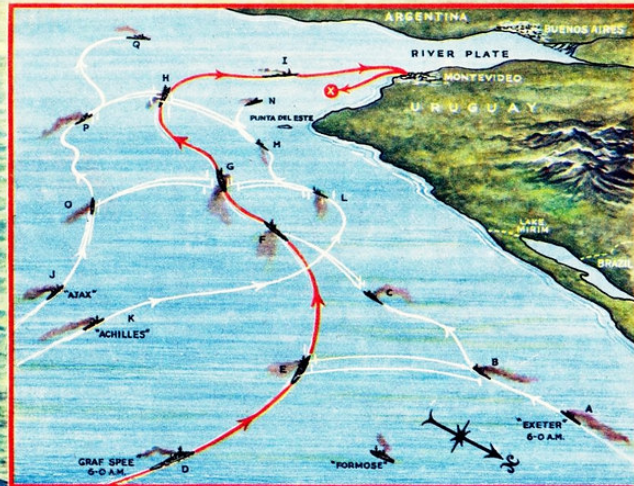
The ship's badge, whose motto translated reads: "None but Ajax can overcome Ajax".



H.M.S. *AJAX* was one of the three British cruisers which took part in the memorable action off the River Plate in December, 1939, against the German pocket-battleship *ADMIRAL GRAF SPEE*. She also goes down in history as being the first cruiser from which an aircraft flew in an action.

KEY TO NUMBERS

(1) Capstan and anchor gear. (2) 'A' turret; two 6-inch guns. (3) 'B' turret; two 6-inch guns. (4) Navigating bridge. (5) Main fire-control tower. (6) Main range-finder. (7) Mainmast. (8) Flag deck with signalling searchlight. (9) Carley floats. (10) Twin 4-inch anti-aircraft guns. (11) Streamlined funnel. (12) 36-inch searchlight. (13) Sea boat. (14) Four port 21-inch torpedo tubes. There are four more in a similar position on the starboard side. (15) Catapult. (16) Fairey *Seafox* seaplane, used for reconnaissance work. (17) Crane. (18) Main topmast. (19) Gaff. (20) Searchlight platform. (21) Spare aircraft. (22) Multiple machine-guns. (23) Aft superstructure. (24) 'X' turret; two 6-inch guns. (25) 'Y' turret; two 6-inch guns. (26) Quarter deck. (27) Ensign staff. (28) Rudder. (29) Port inner and outer propellers. (30) Wardroom. (31) Officers' cabins. (32) Workshops. (33) Marines' quarters. (34) Engine-room artificers' mess. (35) After boiler-room. (36) Forward boiler-room. (37) Port engine-room and turbine. (38) Bulkheads. (39) Double bottom and oil fuel bunkers. (40) Aircraftmen's mess. (41) Seamen's mess. (42) Petty officers' quarters.



APPROXIMATE COURSES TAKEN BY THE COMBATANT WARSHIPS DURING THE BATTLE OF THE PLATE

On the morning of December 13th, 1939, the Nazi pocket-battleship *Admiral Graf Spee* was cruising off the coast of Brazil. She sighted the 9,975-ton French liner *Formose* and immediately gave chase. H.M. Cruiser *Exeter* picked up the latter vessel's distress signals and steamed full speed to the rescue, after signalling her companion cruisers *Ajax* and *Achilles*.

At point (A) on the above diagram, *Exeter* sighted the *Graf Spee*. The enemy ship, short of fuel, turned South in an effort to lose *Exeter*, but *Ajax* and *Achilles* suddenly appeared on the horizon! At (E) and (B), *Graf Spee* and *Exeter* closed and opened fire. Meanwhile, *Formose* was able to escape. By noon, *Exeter*, heavily damaged, was forced to drop out of the action (C). *Ajax* (J) and *Achilles* (K) came racing to the scene. The latter cut in between the *Graf Spee* and the coast (L), (M) and (N). At point (G), the German ship made for the open sea, but *Ajax* foiled this move (O) and (P). Both British ships closed in on each side, firing at point blank range. *Graf Spee* by this time had taken as much punishment as she could stand, and turned towards the neutral port of Montevideo (H) and (I).

Ajax and *Achilles*, determined that their quarry should not escape, took up positions at the mouth of the estuary of the Plate and awaited developments.

Captain Langsdorff, of the *Graf Spee*, asked the authorities at Montevideo for 15 days in which to repair his damaged vessel. This was refused and he was granted 72 hours to make *Graf Spee* seaworthy.

On the orders of Hitler, he headed the ship out towards the waiting British cruisers on the afternoon of December 17th. On passing the three-mile limit, the ship stopped at point (X) and was scuttled. The Captain and crew took off in launches, after setting time-bombs in her interior. These completely shattered the vessel and she sank in 25 ft. of water.

A FLOATING SUCTION GRAIN ELEVATOR

This floating pneumatic grain landing plant is shown discharging Northern Canadian wheat from one of the "Beaver" class ships of the Canadian Pacific Company. These ships are capable of carrying 7,000 tons of grain as well as 2,192 tons of general cargo.

This elevator, which is used by the Port of London Authority, can discharge 110 tons of grain per hour into barges or coasters and can be used anywhere in the docks. The laden barges are then towed to the various flour mills.

Flexible pipes reach right down into the hold of a ship, and suck up the grain by means of a vacuum created by the 230 h.p. Diesel-engine exhausters.

The grain falls to the bottom of the vacuum receiver and dirt and dust are drawn away by the exhausters, which draw out 8,500 cubic feet of air per minute. Grain now at the bottom of the receiver passes through a rotary valve and air lock, after which it is carried to the automatic weighing machine and then discharged into the barges.

KEY TO CYCLE OF OPERATIONS

- (1) No. 2 Hold of 4,200 bushels of Northern wheat.
- (2) Suction nozzles and flexible pipes.
- (3) Boards to prevent grain shifting at sea.
- (4) Sliding hatch covers open and air admitted to hold.
- (5) Suction booms.
- (6) Ball and socket joints.
- (7) Grain falling to bottom of receiver.
- (8) Air lock and discharge valve.
- (9) Bucket conveyor.
- (10) Dirt and dust cyclone exhauster.
- (11) Bucket conveyor discharge head.
- (12) Automatic weighing machines.
- (13) Discharge hopper.
- (14) Discharge pipes (used when grain is required in bags).
- (15) Belt conveyor.
- (16) Grain discharged to barge.
- (17) Fully laden barge ready to be towed away.
- (18) 230 h.p. Diesel engine.
- (19) Air exhausters for maintaining vacuum in receiver.
- (20) Air pipe to exhausters.
- (21) Incoming air is drawn from receiver causing a vacuum (grain falls to bottom).
- (22) Mast and pulleys for booms.
- (23) Only general cargo is handled by ship's derricks.
- (24) Between deck refrigerated spaces.
- (25) Double bottom for water ballast.
- (26) Rat guards.
- (27) Silos for storing grain until required for milling. In this case grain is discharged direct into them from suction elevators on the docks.

THE 10,000 M.P.H. ATOMIC AIRLINER

Already designs for an atomic aircraft are on the way in this country and the U.S.A. In fact the time has come when we can no longer afford *not* to have one. The first prototype will be purely a military project - then the civil atomic airliner will make its debut.

This revolutionary aircraft will be capable of tremendous speeds between 10,000 m.p.h. and 18,000 m.p.h., plus. At these speeds the metal of the aircraft would melt, so to combat this problem an elaborate refrigerator system is installed to keep the metal cool and to make life possible within. We show here our artist's impression of such a machine. If it took off from London airport at 9 a.m. G.M.T. to fly to New York, it would land there at 4.30 a.m. local time the same day - in fact it would be beating the Sun.

To avoid atomic contamination at airfields, the atomic engine would only be used in the upper air at 70,000 ft. to 80,000 ft. Take-offs and landings would be accomplished by chemical rocket motors. The aircraft would climb relatively slowly for 20 minutes; then, for a little over 15 minutes, cruise at 10,000 m.p.h. - 18,000 m.p.h. or even faster; then slow down for the last 20 minutes of its flight, preparatory to landing.

ATOMIC ENGINE

The atomic engine consists of a specially designed atomic pile to create intense heat in a combustion chamber into which will be fed a suitable fuel or combination of fuels. After being ignited and expended, this fuel, in the form of a gaseous stream moving at a terrific velocity, will be thrust out from the rear of the rocket chamber (nozzle) and the reaction of the aircraft to this tremendous thrust will enable it to achieve phenomenal speeds.

During take off and landing, the wings are capable of being adjusted to give maximum lift. It is seen that when the wings are in the forward position, the span is automatically increased. Naturally, during maximum cruising, they are swept back.

KEY TO DRAWING

- (1) Control Cabin. (2) Radar, Navigator, Engineer. (3) Galley. (4) Toilets and Ladies Room.
- (5) Forward Saloon. (6) Machined Titanium Trimmer Wing. (7) Main Entrance Pressure Door.
- (8) Double Shell. Evacuated for Heat Insulation. (9) Ward Robes, Bullion Stowage, etc. (10) Refrigerator unit. (11) Aft Lounge. (12) Firewall. (13) Liquid Oxygen Tanks. (14) Chemical Rockets for take-off and landing. (15) Out-rigger wheels to prevent aircraft from falling over when landing run is finished. (16) Wing web construction. (17) Atomic reactor fuel ammonia propellant. (18) The whole atomic unit can be jettisoned in the event of the engine becoming unstable. (19) Energy shielding. (20) Turbo-pump and ancillary equipment compartment. (21) Graphite and lead honeycomb shielding. (22) Multi-stage compressor, feeding fuel air mixture into heat chamber. (23) Control tubes for pile stabilizing. (24) Atomic pile and heat chamber. (25) Reaction cone. (26) Atomic turbine. (27) Fin and rudder web construction system. (28) Main undercarriage is retracted into bottom of fuselage. The wheel unit is a bogey type.

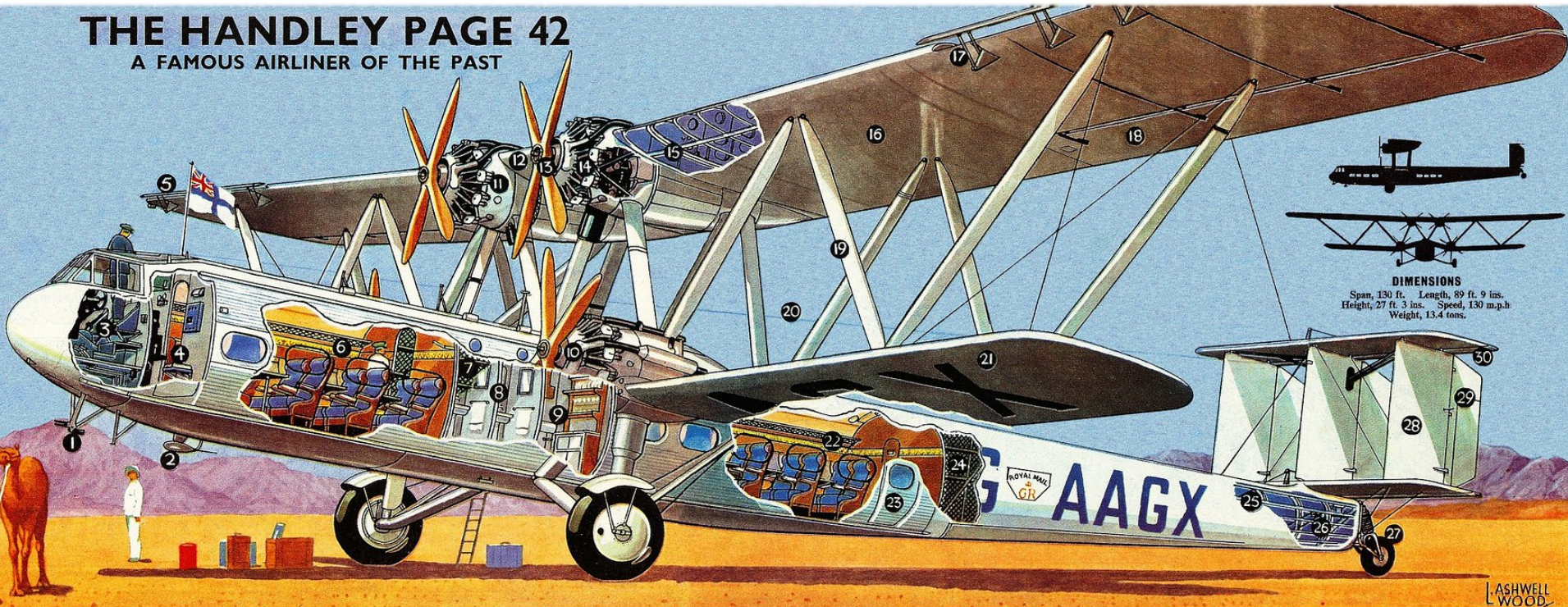
First flying in 1931, the Handley Page 42s — *Heracles* & *Hannibal* class — were among the best-loved airliners ever built. A fleet of eight was ordered by the then Imperial Airways, and they flew well over 7,000,000 miles while carrying 300,000 passengers. Not one passenger was hurt while travelling in these aircraft. Two varieties were built: the *Heracles* type, for service between London, Paris and Egypt; and the *Hannibal* type, for service between Egypt and India. They differed only in the accommodation provided — the *Heracles* type carrying 38 passengers, and the *Hannibal* type 24. All the machines had four engines, mounted in the upper and lower wings — Bristol *Jupiter* air-cooled radials of 550 h.p. each. They were the last of the great biplane airliners. In a future issue of EAGLE, we shall feature the famous *Scipio* class flying-boats of the same period.

KEY TO NUMBERED PARTS

(1) Air-speed indicator head. (2) Wind-driven generator. (3) Captain's and First Officer's seats. (4) Wireless operator's position. (5) Automatic slots for landing. (6) Forward cabin accommodation. These machines set a new standard of luxury and comfort. (7) Amidship mail and luggage compartment. (8) Toilets. (9) Galley. (10) Lower port Bristol *Jupiter* radial engine of 550 h.p. (11) Upper starboard engine. (12) Fuel tanks in upper wing — 500 gallons' capacity. (13) Propellers — 11 ft. 3½ ins. in diameter. (14) Upper port engine. (15) Central section of upper wing. (16) Upper wing, of metal construction covered with fabric. (17) Automatic slots. When opened, these slots prevent stalling during landing. (18) Port aileron. (19) Inter-wing struts. (20) Wireless aerial. (21) Lower wing. (22) Aft cabin. (23) Passengers' entrance-door. (24) Luggage and freight hold. (25) Elevator controls. (26) Rudder controls. (27) Tail-wheel. (28) The biplane tail-unit had three rudders. (29) Rudder balance. (30) Elevators, upper and lower.

THE HANDLEY PAGE 42

A FAMOUS AIRLINER OF THE PAST

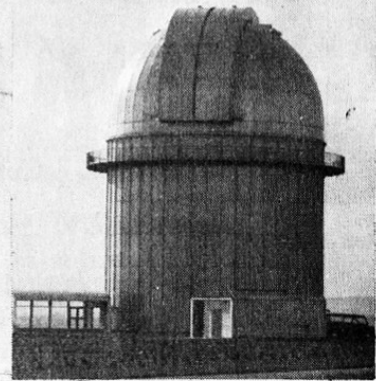


DIMENSIONS

Span, 130 ft. Length, 89 ft. 9 ins.
Height, 27 ft. 3 ins. Speed, 130 m.p.h.
Weight, 13.4 tons.

SEARCHING FOR THE UNKNOWN

The outside dome of the Sir Isaac Newton Telescope in the grounds of Herstmonceux Castle, near Hailsham, Sussex



Britain's latest telescope and the largest in Europe is the 98-inch Sir Isaac Newton Telescope recently put into operation for the Royal Observatory at Herstmonceux, Sussex. The telescope is the reflecting type with a 98-inch circular mirror, the sole function of which is to collect as much light as possible from the distant stars and planets. At the top of the telescope a much smaller mirror reflects the light back to the eye of the observer. Another mirror can reflect the light into a spectroscope housed in a room below. Spectrographic instruments will analyse the colour of starlight and their elements. The work of the new telescope will study dynamics of the universe and a new class of mysterious objects, called Quasars, which radiate enormous quantities of energy but are far too distant to register on earth. The public may view the telescope, free of charge, every weekday afternoon between 2 p.m. and 4 p.m. and 11 a.m. to 4 p.m., week-ends.

KEY TO HOW IT WORKS

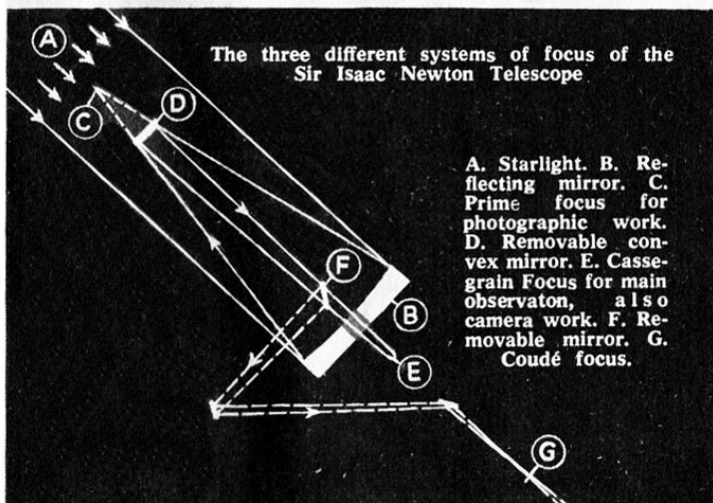
(1) Observation opening in dome. (2) Light rays from distant stars or planets. (3) Prime Focus for photographic work; an observer's cage is fitted when used. (4) Hinged convex mirror for Cassegrain and Coudé Focus. (5) Reflected rays from mirror. (6) Tubular steel structure. (7) Focus tube. (8) Hinged mirrors for Coudé Focus. (9) Main 98-in.-diameter reflecting mirror. This makes a star appear 250,000 times as bright as the eye sees it. (10) Declination balance weight. (11) Second mirror for Coudé Focus. (12) Public viewing gallery. (13) Power control desk. (14) Observing floor. (15) East movement of Polar axis. (16) Observer's platform. (17) Third mirror for Coudé focus. (18) Observer's cage. (19) Eyepiece and lens for Cassegrain Focus. This is the main focus being used. (20) Telescope support columns. (21) Declination gears and motor. (22-23) Declination axis and movement. (24) Double skin insulated dome. (25) Rollers of rotating dome. (26) West movement of polar axis. (27) Gear drive for East-West movement. (28) Gear wheel and roller bearings of rotating polar disc. (29) North-South polar axis of disc; this corresponds to the earth's axis. (30) Oil bearing pads for polar disc. (31) Coudé Focus. (32) Concrete support pylon for telescope. (33) The Coudé Focus is a fixed position and goes down to spectrographic instruments and electronics in the room below.

AN EAGLE
cutaway
DRAWING

ASHWELL
WOOD

The three different systems of focus of the Sir Isaac Newton Telescope

A. Starlight. B. Reflecting mirror. C. Prime focus for photographic work. D. Removable convex mirror. E. Cassegrain Focus for main observation, also camera work. F. Removable mirror. G. Coudé focus.



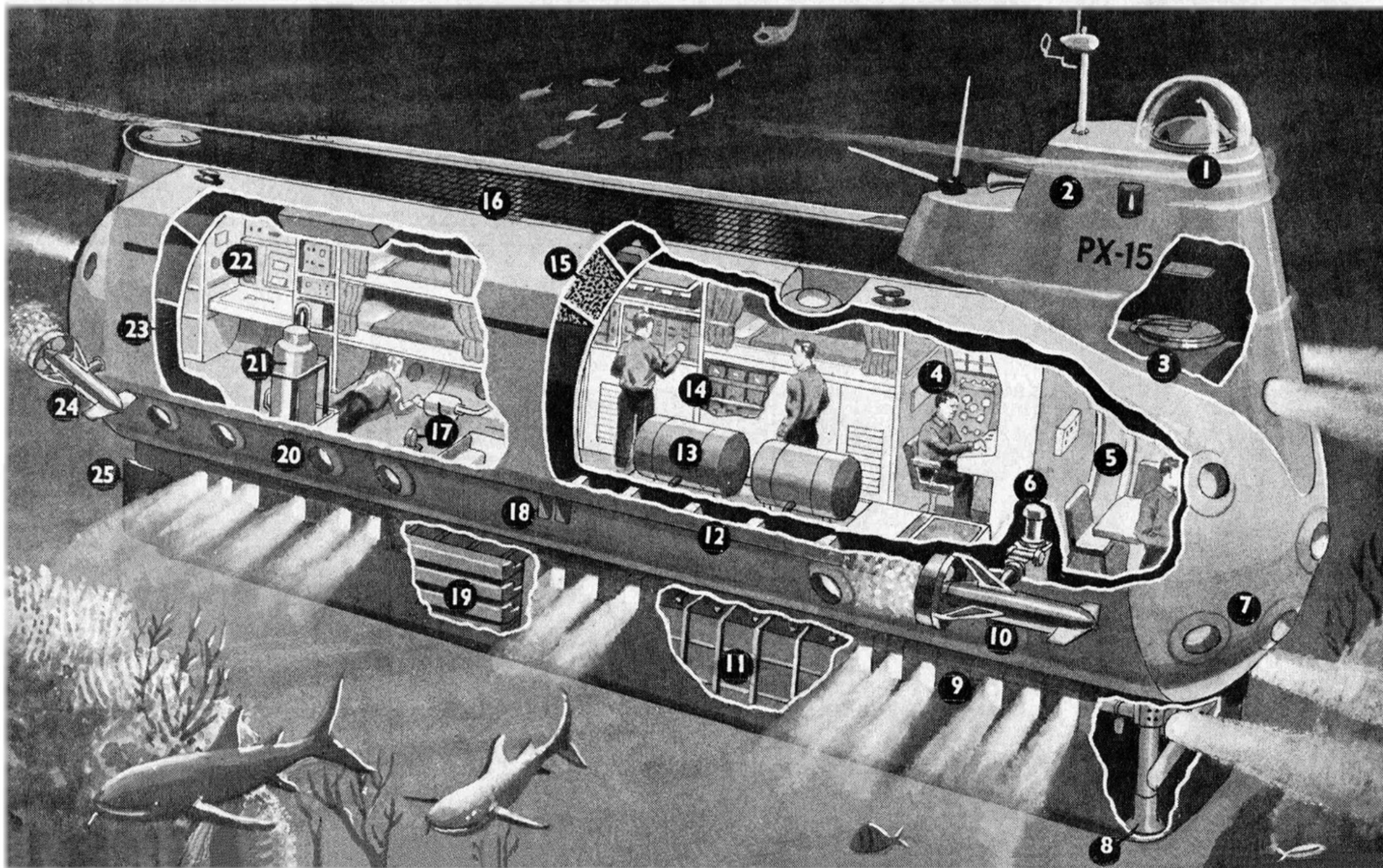
What Makes The Gulf Stream Flow?

This cutaway was part of a series captioned "The Futurescope" and was not actually an "Eagle Cutaway Drawing". However, it is included as the issue had no other cutaway and this drawing is too good to ignore. Some other "Futurescope" articles had cutaways, but rarely of similar detail.

The miniature submarine PX-15 under construction

KEY TO THE PX-15

- (1) Hatch and surface lookout. (2) Conning tower — radio and surface radar above. (3) Hatch and pressure hull. (4) Operational control centre. (5) Mess and wardroom. (6) Motor swivel gearbox. (7) Viewing ports. (8) Support legs when resting on sea-bed. (9) Side lights. (10) Forward starboard propulsion motor propeller — all four 25 m.p.h. motors swivel for vertical or horizontal propulsion. (11) Batteries for all electrical power. (12) Ballast tank and pressure hull. (13) Hot water tanks. (14) Battery inverters. (15) Iron shot—released in an emergency to bring craft to surface. (16) Walkway. (17) Biological sampler and cine-camera. (18) Side-looking sonar. (19) Battery oil containers. (20) Viewing ports. (21) Oxygen tank. (22) Scientific control centre. (23) Ballast tank. (24) Rear starboard propulsion motor. (25) Rudder for steering.



THE SNOWDON MOUNTAIN RAILWAY

The Snowdon Mountain Railway was opened to public traffic on April 6th, 1896, and it remains to-day unique, being the only one of its type in the United Kingdom.

The lower terminus is situated at picturesque Llanberis, and from there the railway climbs continually for just under 4½ miles to the summit – topping an altitude of 3,493 feet above sea-level.

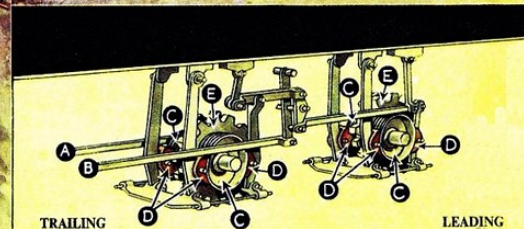
The railway is built on the Abt system, named after the eminent Swiss engineer, Dr Roman Abt, who first evolved it.

The locomotive is not coupled to the coach, and it therefore pushes from behind on the ascent of the mountain.

Altogether there are now seven locomotives operating on the railway. No. 1, which bore the name of "LADAS", was destroyed early in its career.

KEY TO NUMBERS.

(1) Two Rackrails laid side by side with teeth 'staggered'. (2) Guard Rails laid each side of Rack. Safety-grippers suspended beneath loco embrace these, thus preventing any possibility of the engine wheels mounting the trackrails. (3) Coal bunker. Capacity 11.8 cwt. (4) Side water tanks. Total capacity 525 gallons. (5) Cab gate. (6) Whistle. (7) Driving cab. (8) Firebox stays. (9) Firebox. (10) Throttle valve in dome. (11) Fire tubes for heating water. (12) Water level. This must be kept high to ensure that the firebox crown is always well covered. (13) Boiler with an inclination of 1 in 11. (14) Chimney bonnet. This is put on at the Summit Station and damps the natural draught of the fire on the descending journey. (15) Superheater. (16) Smokebox. (17) Crosshead. (18) Slide bar. (19) Rocker arm. (20) Piston rod. (21) Valve rocker. (22) Piston. (23) Outside frame. (24) Pinion coupling rod. The road wheels are not coupled. (25) Road wheels. These play no part in the drive of the locomotive, but ride 'loose' on the pinion shafts which serve as carrying axles. (26) Trailer truck wheels. (27) Trailer truck swivel. (28) Inside frame. (29) Wheel housing which allows road wheels to revolve freely on pinion shaft. (30) Two rack pinions fixed to pinion shaft. There are also two more on the leading shaft, making four in all. These drive the locomotive by climbing tooth by tooth along the rackrail. The two lots of teeth are set permanently out of step in such a manner that one set is always in maximum engagement with the teeth of the rackrail during each successive disengagement of the other. (31) Tail rod cover. (32) Piston valves. (33) Cylinder. (34) Steel sleepers. (35) Track Gauge 2 ft. 7½ inches.



TRAILING

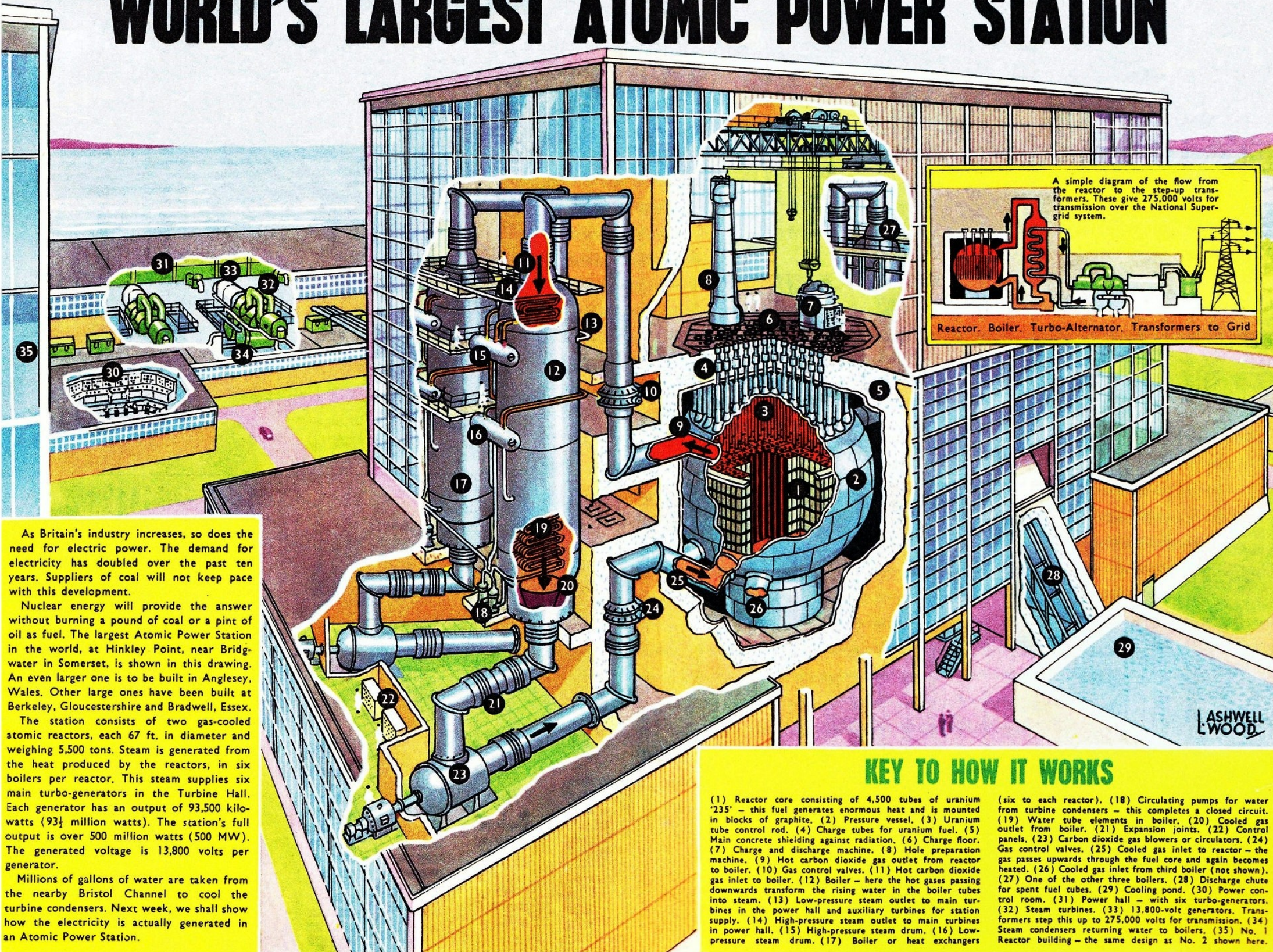
LEADING

(Top) Train crossing Afon Hwch Viaduct with one of the latest type coaches soon after leaving the lower terminus at Llanberis. The viaduct has a gradient of 1 in 8½.

(Lower) Diagram of the Snowdon friction brake gear. The brake gear is omitted from the large illustration for the sake of clarity.

An ingenious system of levers and linkages automatically equalizes the braking force of eight shoes, two to each driving pinion. It can be applied by hand or by steam. (A) Fireman's pull-rod. (B) Driver's pull-rod. (C) Corrugated drums fixed on shaft each side of pinions. (D) Grooved blocks which contract about drums. (E) Pinions. Duplicate set of levers not shown.

WORLD'S LARGEST ATOMIC POWER STATION

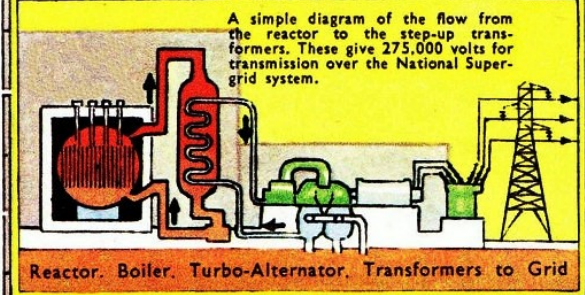


As Britain's industry increases, so does the need for electric power. The demand for electricity has doubled over the past ten years. Suppliers of coal will not keep pace with this development.

Nuclear energy will provide the answer without burning a pound of coal or a pint of oil as fuel. The largest Atomic Power Station in the world, at Hinkley Point, near Bridgwater in Somerset, is shown in this drawing. An even larger one is to be built in Anglesey, Wales. Other large ones have been built at Berkeley, Gloucestershire and Bradwell, Essex.

The station consists of two gas-cooled atomic reactors, each 67 ft. in diameter and weighing 5,500 tons. Steam is generated from the heat produced by the reactors, in six boilers per reactor. This steam supplies six main turbo-generators in the Turbine Hall. Each generator has an output of 93,500 kilowatts (93½ million watts). The station's full output is over 500 million watts (500 MW). The generated voltage is 13,800 volts per generator.

Millions of gallons of water are taken from the nearby Bristol Channel to cool the turbine condensers. Next week, we shall show how the electricity is actually generated in an Atomic Power Station.



KEY TO HOW IT WORKS

- (1) Reactor core consisting of 4,500 tubes of uranium '235' - this fuel generates enormous heat and is mounted in blocks of graphite. (2) Pressure vessel. (3) Uranium tube control rod. (4) Charge tubes for uranium fuel. (5) Main concrete shielding against radiation. (6) Charge floor. (7) Charge and discharge machine. (8) Hole preparation machine. (9) Hot carbon dioxide gas outlet from reactor to boiler. (10) Gas control valves. (11) Hot carbon dioxide gas inlet to boiler. (12) Boiler - here the hot gases passing downwards transform the rising water in the boiler tubes into steam. (13) Low-pressure steam outlet to main turbines in the power hall and auxiliary turbines for station supply. (14) High-pressure steam outlet to main turbines in power hall. (15) High-pressure steam drum. (16) Low-pressure steam drum. (17) Boiler or heat exchangers (six to each reactor). (18) Circulating pumps for water from turbine condensers - this completes a closed circuit. (19) Water tube elements in boiler. (20) Cooled gas outlet from boiler. (21) Expansion joints. (22) Control panels. (23) Carbon dioxide gas blowers or circulators. (24) Gas control valves. (25) Cooled gas inlet to reactor - the gas passes upwards through the fuel core and again becomes heated. (26) Cooled gas inlet from third boiler (not shown). (27) One of the other three boilers. (28) Discharge chute for spent fuel tubes. (29) Cooling pond. (30) Power control room. (31) Power hall - with six turbo-generators. (32) Steam turbines. (33) 13,800-volt generators. Transformers step this up to 275,000 volts for transmission. (34) Steam condensers returning water to boilers. (35) No. 1 Reactor building - the same design as No. 2 shown here.

ASHWELL
L'WOOD

LOCOMOTIVE COALING PLANTS, AND HOW THEY WORK

WAGON HOIST TYPE (Left)

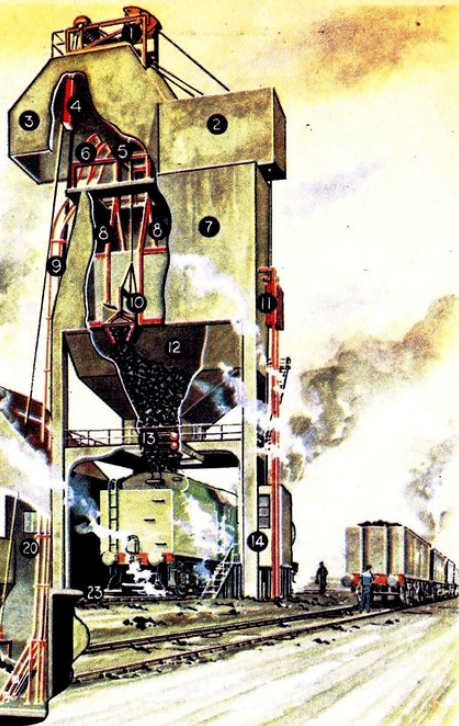
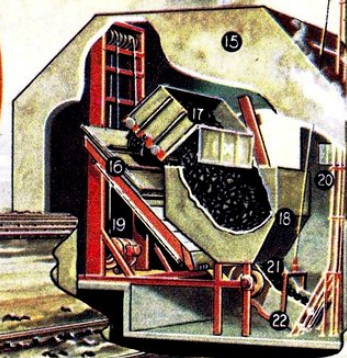
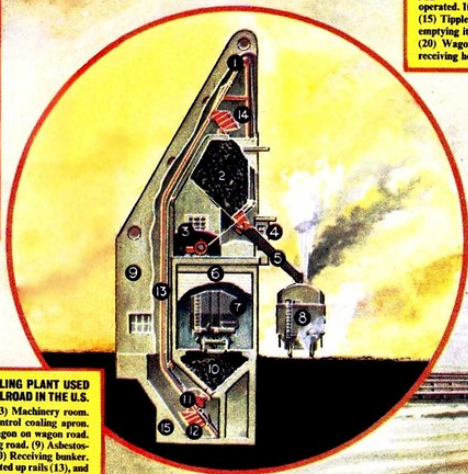
This is the most modern type of coaling plant in use on British Railways. (1) Machinery house. (2) Cable-winding drums worked by - (3) 30 h.p. electric motor fitted with magnetic brake. (4) Wagon cradle counterweights. (5) Hood. (6) Counterweight guides. (7) Galleries. (8) Hand winch for operating two-way flap. (9) Reinforced concrete structure. (10) Receiving bunker. (11) Two-way flap which can be operated to close the opening of one or the other of the two storage bunkers, thus enabling coal to be shot into the one left open. (12) Bulkhead dividing storage bunkers. (13) Anti-breakage trunks. (14) and (15) Storage bunkers, each of 75 tons capacity. These bunkers allow for two grades, or qualities, of coal to be stored ready for feeding to locomotives as required. (16) Hoisting cables. (17) 5 h.p. electric motors for operating jig feeders. (18) Coal being gravity-fed to jig feeder. (19) Water pipe connected to sprays for damping down coal-dust during operations. (20) Three-way flap which can be controlled to regulate the feeding of coal to the tender. (21) Operating shaft and linkages for three-way flap. (22) Meter automatically recording amount of coal supplied. (23) Tender of locomotive on coaling road receiving supply of coal. (24) Operators' cabins. (25) Control cabin. (26) Exterior gallery. (27) Cradle runways. (28) Coal wagon in position on cradle. (29) Wagon road. (30) Wagon cradle. The wagon is hoisted bodily upon this into the hood (5), where it automatically tilts, tipping its contents into receiving bunker (10). (31) Concrete-lined pit.

SKIP HOIST TYPE (Right)

(1) Head sheave (2) Skip control room. (3) Hood. (4) Skip hoist counterweight. (5) Exchange platform for skips. (6) The coal is tipped here into the anti-breakage skip for transference to storage bunkers. (7) Reinforced concrete structure. (8) Switches for the two storage bunkers. (9) Skip hoist runways. (10) Anti-breakage skip. (11) Anti-breakage skip counterweight. (12) Storage bunker; capacity 160 tons. A second bunker of 90 tons capacity is situated beyond this. The former for best coal, and the latter for common coal. (13) Electric jigger feeders. (14) Control cabin from which the jigger feeders are operated. It also contains a meter to record the amount of coal supplied. (15) Tippler house. (16) Tippler. (17) Coal wagon, hoisted on tippler, emptying its load into receiving hopper (18). (19) Electric tippler gear. (20) Wagon control cabin. (21) Chute. (22) Skip being filled from receiving hopper. (23) Locomotive on coaling road.

ULTRA-MODERN DESIGN OF COALING PLANT USED ON THE CHESAPEAKE & OHIO RAILROAD IN THE U.S.

(1) Head sheave. (2) Coal bunker. (3) Machinery room. (4) Operator's cabin. (5) Remote-control coaling apron. (6) Rolling door. (7) Coal hopper wagon on wagon road. (8) Locomotive in position on coaling road. (9) Asbestos-protected metal-sheeted structure. (10) Receiving bunker. (11) Loader. (12) Bucket which is hoisted up rails (13), and tips its contents (14) into storage bunker. (15) Concrete foundations.



90 miles an hour! That is the speed reached by the world's longest daily, non-stop express between London and Edinburgh, a distance of 392½ miles in 6½ hours, at an average speed of just over 58 m.p.h. The Elizabethan, British Railways Coronation Year crack express, leaves King's Cross daily at 9.35 a.m. and arrives in Edinburgh at 4.20 p.m. The up

Elizabethan leaves Edinburgh at 9.25 a.m. and arrives at King's Cross at 4.30 p.m. The locomotive shown here is the Walter K. Whigham, No. 60028, an A4 class, 3-cylinder 4-6-2 Streamlined Pacific. Two crews are carried. A London driver and fireman take the train to Tollerton, about half-way, where two Edinburgh men take over by means of the corridor tender as shown.

THE WORLD'S LONGEST NON-STOP TRAIN

KEY TO HOW IT WORKS

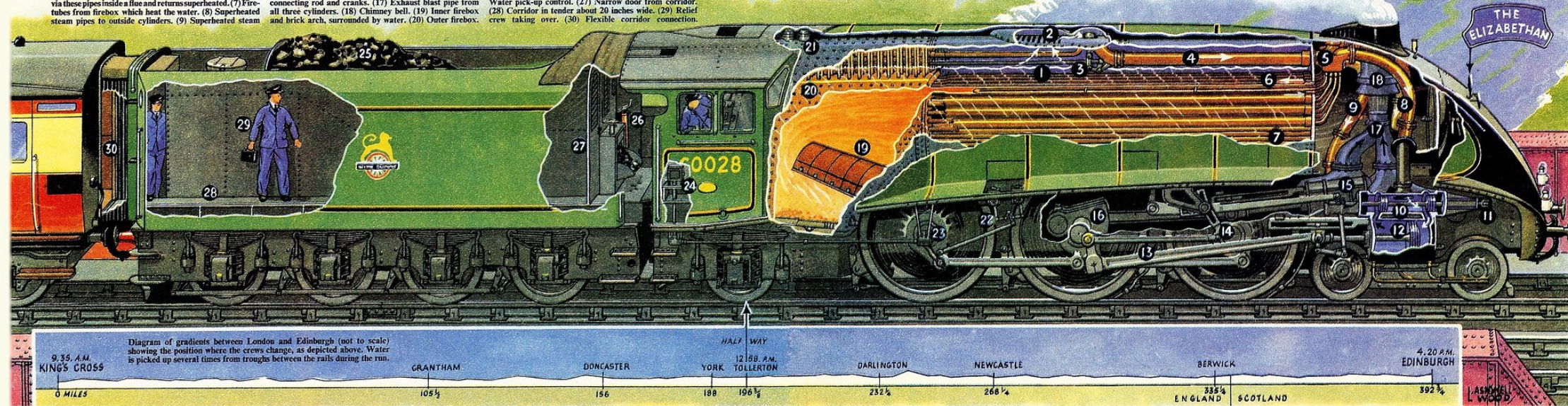
(1) Water level over firebox. (2) Steam rises to this dome and is admitted by regulator valve to steam pipe. (3) Driver's regulator control. (4) Steam pipe to superheater. (5) Superheater element. (6) Steam passes back into boiler via these pipes inside a flue and returns superheated. (7) Fire-tubes from firebox which heat the water. (8) Superheated steam pipes to outside cylinders. (9) Superheated steam

pipe to inside cylinder. (10) Piston valves which control steam entry and exhaust. (11) Motion for piston valves of inside cylinder. (12) Piston on the backward stroke. (13) Outside connecting rod to driving wheels. (14) Walschaert gear for working piston valves. (15) Inside cylinder. (16) Inside connecting rod and cranks. (17) Exhaust blast pipe from all three cylinders. (18) Chimney bell. (19) Inner firebox and brick arch, surrounded by water. (20) Outer firebox.

(21) Safety valves. (22) Drive to mechanical oil lubricators. (23) Speedometer drive. (24) Speed recorder.

KEY TO TENDER

(25) Coal capacity: 9 tons. Water: 5,000 gallons. (26) Water pick-up control. (27) Narrow door from corridor. (28) Corridor in tender about 20 inches wide. (29) Relief crew taking over. (30) Flexible corridor connection.



FUTURE ATOMIC POWER STATION

In this exclusive *Eagle* feature we show how the use of atomic power will be applied to the generation of electricity.

Based on scientific facts, and already drawn up, this power station will be circular in shape with the atomic 'pile' or reactor in the centre. This is the 'heart beat' of the system wherein atoms of uranium 235 are exploded and the forces so created are harnessed to produce tremendous energy and heat.

This heat is used to produce steam in three sets of boilers, or heat exchangers. The six boilers to each set will supply steam to drive a turbine, which, in turn, drives a generator to produce electricity. The three turbines (only two are shown) are arranged radially round the floor of the power station and either one or all can be used independently.

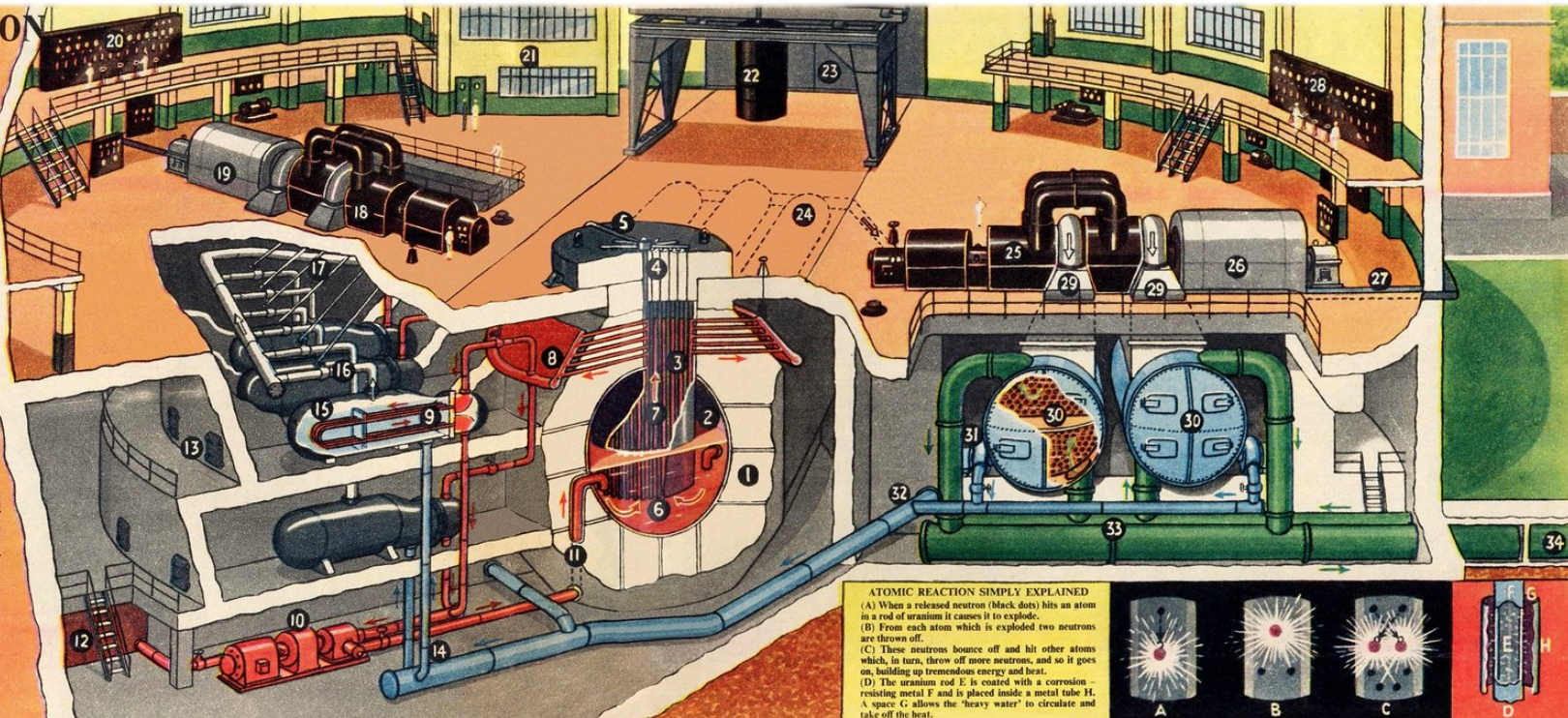
Such a power station, though costly, would do away with the huge boilers used in present day power stations and save millions of tons of coal yearly.

KEY TO HOW IT WORKS

(1) Thick concrete shield round reactor to prevent radiation. (2) Spherical atomic or nuclear reactor. (3) Tubes with rods of uranium 235 inside (the fuel). (4) Rods controlling the reactor. (5) Shielded charging door. (6) 'Heavy water', called Deuterium or D2O. This acts as a moderator for the released neutrons and also carries off the great heat. The level is maintained by interior pressure. (7) 'Heavy water' rises up between the tubes. (8) Super-heated 'heavy water' passes to the heat exchangers. (9) 'Heavy water' pipes in heat exchanger. Here the distilled water from the turbine condensers is immediately turned into steam. (10) 'Heavy water' circulating pumps. (11) 'Heavy water' returns to reactor for re-heating and so goes round and round. (12) 'Heavy water' storage tanks for replacing the supply. (13) Inspection trap doors in the heavily shielded heat exchanger chambers. (14) Distilled water supply

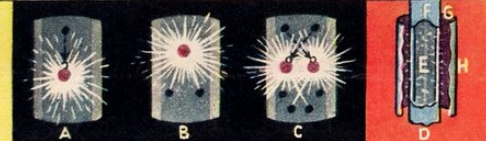
from turbine condensers. (15) Heat exchanger or boiler. There are six of these to each turbine in two banks of three each. (16) Super-heated steam pipes to turbine. (17) Steam controls from control room. (18) Steam turbine. (19) Electricity generator. (20) Switchboard. (21) Control room. Here the various temperatures and the working of the reactor is controlled, together with the steam supply and the turbines. (22) Charger containing tubes of uranium 235 for recharging the reactor when necessary. (23) Doors to uranium 235 supply the fuel. (24) Position of the set of heat exchangers supplying steam to the turbine on the right. (25) Steam turbine. (26) Electricity generator. (27) 11,000 volt cables to transformers and switch house. (28) Switchboard. (29)-(29) Exhaust steam chests to condensers. (30)-(30) Exhaust steam condensers. Here the steam is passed round the tubes of the cold circulating water and is

condensed into distilled water. (31) Distilled water pump. (32) Distilled water pipe to heat exchangers; thus the water and steam go round in a closed circuit. (This pipe, of course, should be connected to the set of heat exchangers, No. 24, belonging to this turbine, but is shown here going to the other set for the sake of simplicity.) (33) Cold water circulating pipes. (34) Circulating water pipes to control valves. This water is usually drawn from a nearby river.



ATOMIC REACTION SIMPLY EXPLAINED

(A) When a released neutron (black dots) hits an atom in a rod of uranium it causes it to explode.
(B) From each atom which is exploded two neutrons are thrown off.
(C) These neutrons bounce off and hit other atoms which, in turn, throw off more neutrons, and so it goes on, building up tremendous energy and heat.
(D) The uranium rod is coated with a corrosion-resisting metal F and is placed inside a metal tube H. A space G allows the 'heavy water' to circulate and take off the heat.



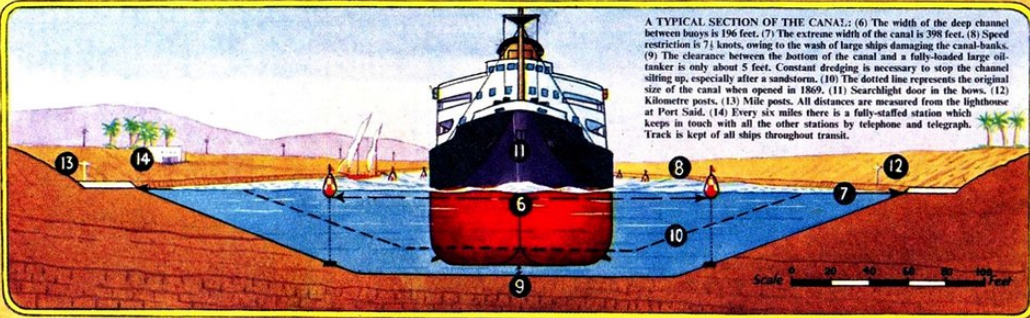
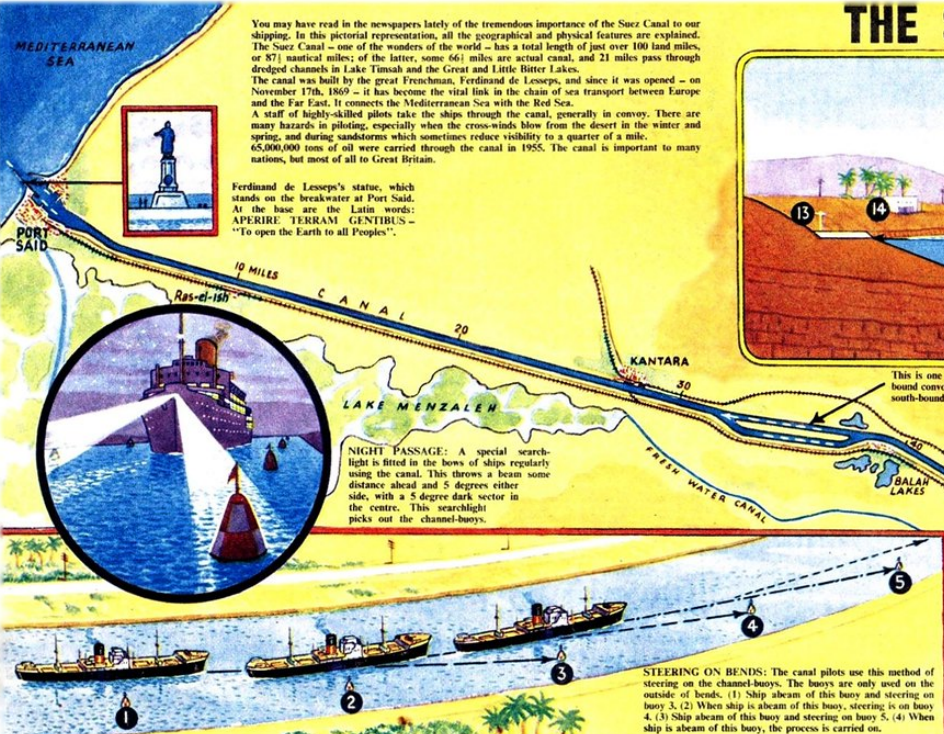
THE SUEZ CANAL—AND ITS NAVIGATION

You may have read in the newspapers lately of the tremendous importance of the Suez Canal to our shipping. In this pictorial representation, all the geographical and physical features are explained. The Suez Canal—one of the wonders of the world—has a total length of just over 100 land miles, or 87½ nautical miles; of the latter, some 66½ miles are actual canal, and 21 miles pass through dredged channels in Lake Timsah and the Great and Little Bitter Lakes.

The canal was built by the great Frenchman, Ferdinand de Lesseps, and since it was opened—on November 17th, 1869—it has become the vital link in the chain of sea transport between Europe and the Far East. It connects the Mediterranean Sea with the Red Sea.

A staff of highly-skilled pilots take the ships through the canal, generally in convoy. There are many hazards in piloting, especially when the cross-winds blow from the desert in the winter and spring, and during sandstorms which sometimes reduce visibility to a quarter of a mile. 65,000,000 tons of oil were carried through the canal in 1955. The canal is important to many nations, but most of all to Great Britain.

Ferdinand de Lesseps's statue, which stands on the breakwater at Port Said. At the base are the Latin words: APERIRE TERRAM GENTIBUS—"To open the Earth to all Peoples".



A TYPICAL SECTION OF THE CANAL: (6) The width of the deep channel between buoys is 196 feet. (7) The extreme width of the canal is 398 feet. (8) Speed restriction is 7½ knots, owing to the wash of large ships damaging the canal-banks. (9) The clearance between the bottom of the canal and a fully-loaded large oil-tanker is only about 5 feet. Constant dredging is necessary to stop the channel silting up, especially after a sandstorm. (10) The dotted line represents the original size of the canal when opened in 1869. (11) Searchlight door in the bows. (12) Kilometre posts. (13) Mile posts. All distances are measured from the lighthouse at Port Said. (14) Every six miles there is a fully-staffed station which keeps in touch with all the other stations by telephone and telegraph. Track is kept of all ships throughout transit.

This is one of the bypass points. The north-bound convoy of ships is passing on, whilst the south-bound convoy is stopped.

The canal channel is dredged in the Great Bitter Lake. In the centre, a north-bound and a south-bound convoy may pass—one of the convoys being stopped temporarily whilst the other passes.

NIGHT PASSAGE: A special searchlight is fitted in the bows of ships regularly using the canal. This throws a beam some distance ahead and 5 degrees either side, with a 5 degree dark sector in the centre. This searchlight picks out the channel-buoys.

STEERING ON BENDS: The canal pilots use this method of steering on the channel-buoys. The buoys are only used on the outside of bends. (1) Ship abreast of this buoy and steering on buoy 3. (2) When ship is abreast of this buoy, steering is on buoy 4. (3) Ship abreast of this buoy and steering on buoy 5. (4) When ship is abreast of this buoy, the process is carried on.



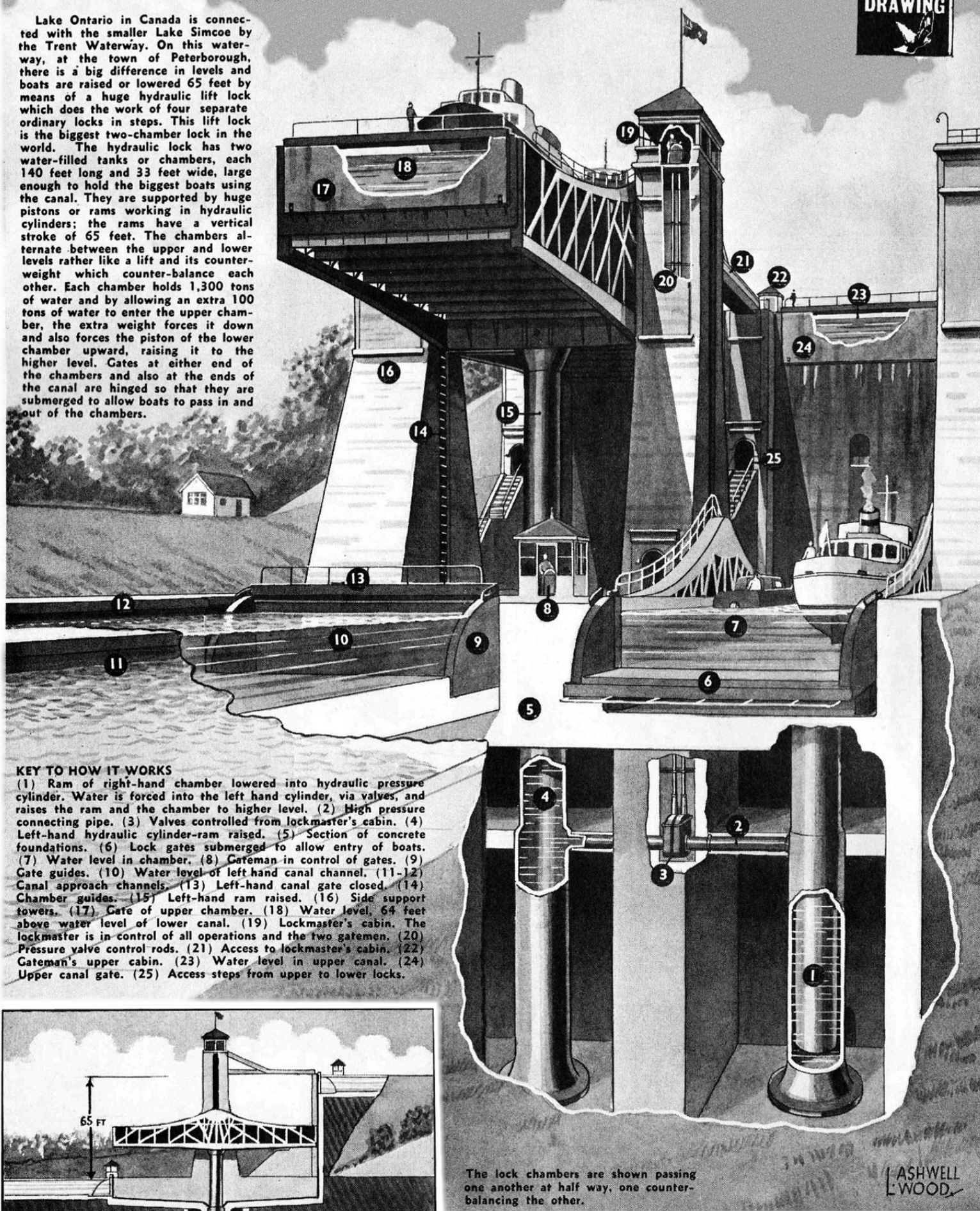
SHIPS IN A YEAR'S PASSAGE: A total of 14,380 ships used the canal in 1955—nearly 40 per day. Just over a quarter of these (28%) were British.

7,863 OIL TANKERS 5,234 CARGO SHIPS 1,283 PASSENGER SHIPS

WATERWAY IN THE SKY



Lake Ontario in Canada is connected with the smaller Lake Simcoe by the Trent Waterway. On this waterway, at the town of Peterborough, there is a big difference in levels and boats are raised or lowered 65 feet by means of a huge hydraulic lift lock which does the work of four separate ordinary locks in steps. This lift lock is the biggest two-chamber lock in the world. The hydraulic lock has two water-filled tanks or chambers, each 140 feet long and 33 feet wide, large enough to hold the biggest boats using the canal. They are supported by huge pistons or rams working in hydraulic cylinders; the rams have a vertical stroke of 65 feet. The chambers alternate between the upper and lower levels rather like a lift and its counter-weight which counter-balance each other. Each chamber holds 1,300 tons of water and by allowing an extra 100 tons of water to enter the upper chamber, the extra weight forces it down and also forces the piston of the lower chamber upward, raising it to the higher level. Gates at either end of the canal are hinged so that they are submerged to allow boats to pass in and out of the chambers.



KEY TO HOW IT WORKS

(1) Ram of right-hand chamber lowered into hydraulic pressure cylinder. Water is forced into the left hand cylinder, via valves, and raises the ram and the chamber to higher level. (2) High pressure connecting pipe. (3) Valves controlled from lockmaster's cabin. (4) Left-hand hydraulic cylinder-ram raised. (5) Section of concrete foundations. (6) Lock gates submerged to allow entry of boats. (7) Water level in chamber. (8) Gateman in control of gates. (9) Gate guides. (10) Water level of left hand canal channel. (11-12) Canal approach channels. (13) Left-hand canal gate closed. (14) Chamber guides. (15) Left-hand ram raised. (16) Side support towers. (17) Gate of upper chamber. (18) Water level, 64 feet above water level of lower canal. (19) Lockmaster's cabin. The lockmaster is in control of all operations and the two gatemen. (20) Pressure valve control rods. (21) Access to lockmaster's cabin. (22) Gateman's upper cabin. (23) Water level in upper canal. (24) Upper canal gate. (25) Access steps from upper to lower locks.

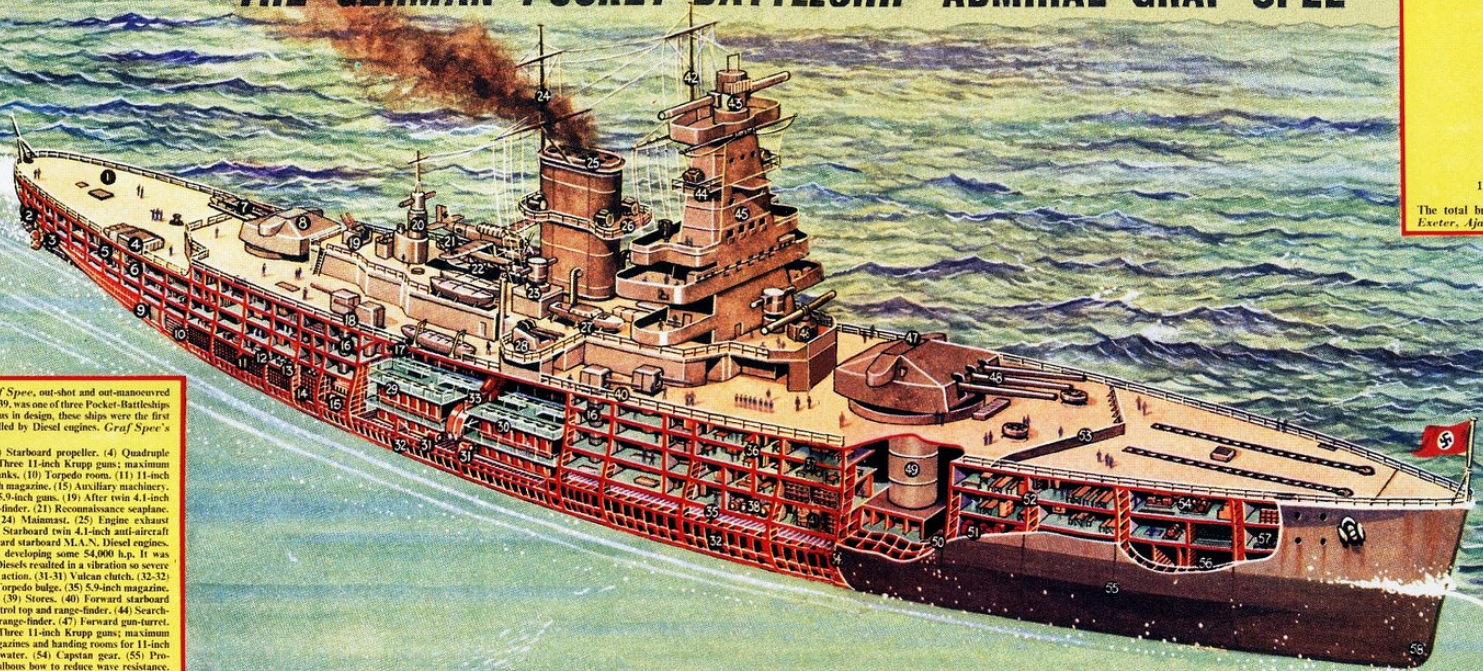
The lock chambers are shown passing one another at half way, one counter-balancing the other.

LASHWELL
L'WOOD

THE GERMAN POCKET-BATTLESHIP ADMIRAL GRAF SPEE

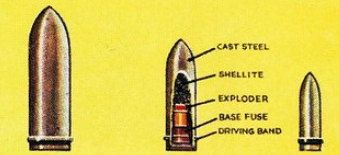
The 10,000 ton German Pocket-Battleship *Admiral Graf Spee*, out-shot and out-manoeuvred by three British cruisers at the Battle of the River Plate in 1939, was one of three Pocket-Battleships serving in the German Navy during World War II. Ingenious in design, these ships were the first of such size to have electrically welded hulls, and to be propelled by Diesel engines. *Graf Spee*'s engines gave her a remarkable speed of 26 knots!

KEY TO NUMBERS: (1) Quarter deck, (2) Rudder, (3) Starboard propeller, (4) Quadruple torpedo tubes, (5) Officers' quarters, (6) Ship's office, (7) Three 11-inch Krupp guns; maximum range, 30,000 yards, (8) After gun-turret, (9) Fresh-water tanks, (10) Torpedo room, (11) 11-inch magazine, (12) Operating theatre, (13) Sick bay, (14) 5.9-inch magazine, (15) Auxiliary machinery, (16) Gun trunk, (17) Engineers' mess, (18) After starboard 5.9-inch guns, (19) After twin 4.1-inch anti-aircraft guns, (20) After main director-tower and range-finder, (21) Reconnaissance seaplane, (22) Catapult, (23) Secondary armament director-tower, (24) Mainmast, (25) Engine exhaust vents, (26) Searchlight platform, (27) Admiral's barge, (28) Starboard twin 4.1-inch anti-aircraft guns, (29) After starboard M.A.N. Diesel engines, (30) Forward starboard M.A.N. Diesel engines. Altogether there are eight sets of these engines employed, developing some 54,000 h.p. It was reported, at the time, that the high speed produced by these Diesels resulted in a vibration so severe as to interfere with accurate shooting during the River Plate action, (31-31) Vulcan clutch, (32-32) Oil fuel tanks in double hull, (33) Starboard gear-box, (34) Torpedo bulge, (35) 5.9-inch magazine, (36) Petty Officers' mess, (37) Seamen's mess, (38) Fans, (39) Stores, (40) Forward starboard 5.9-inch guns, (41) Armourer, (42) Foremast, (43) Upper control top and range-finder, (44) Searchlight platform, (45) Control tower, (46) Conning tower and range-finder, (47) Forward gun-turret. These turrets are fitted with bomb-deflecting crowns, (48) Three 11-inch Krupp guns; maximum range, 30,000 yards, (49) Main ammunition trunk, (50) Magazines and handling rooms for 11-inch guns, (51) Compressors, (52) Seamen's mess, (53) Breakwater, (54) Capstan gear, (55) Pronounced chine, (56) Chain locker, (57) Paint store, (58) Bulbous bow to reduce wave resistance.



WEIGHT OF SHELL AND BROADSIDE OF THE SHIPS ENGAGED IN THE BATTLE OF THE RIVER PLATE COMPARED

"GRAF SPEE" "EXETER" "AJAX" & "ACHILLES"



11IN. SHELL-670 LBS. 8IN. SHELL-256 LBS. 6IN. SHELL-100 LBS.

The total broadside of the *Spee* weighed 4,708 lbs. The COMBINED total broadside of *Exeter*, *Ajax* and *Achilles* weighed 3,136 lbs!

RIVETING AND WELDING COMPARED



This diagram illustrates how angle pieces and rivets considerably increase weight as compared to welded joints. By using the latter method in the construction of the *Graf Spee*, it effected a saving of 550 tons.

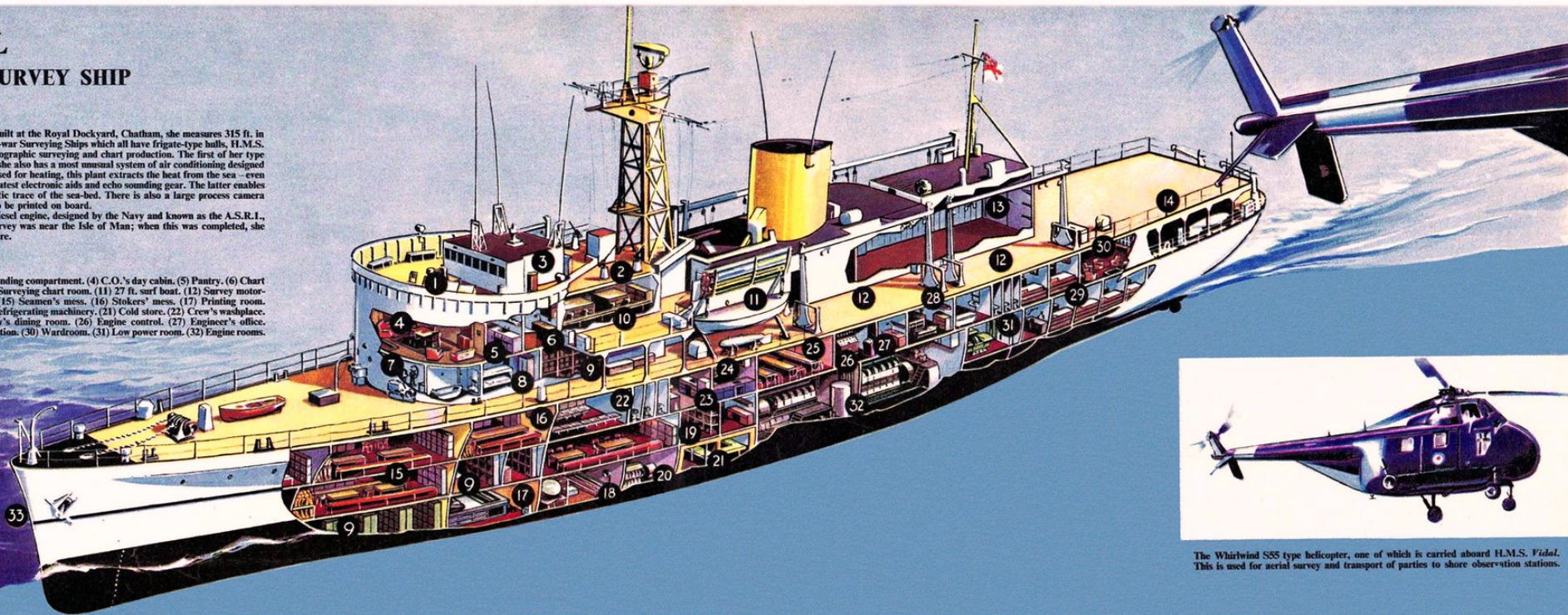
H.M.S. VIDAL

BRITAIN'S LATEST SURVEY SHIP

H.M.S. *Vidal* is Britain's latest Surveying Ship. Built at the Royal Dockyard, Chatham, she measures 315 ft. in length and 40 ft. in breadth. In contrast to other post-war Surveying Ships which all have frigate-type hulls, H.M.S. *Vidal* was specially designed for the work of hydrographic surveying and chart production. The first of her type to be fitted with a helicopter hangar and flight deck, she also has a most unusual system of air conditioning designed to keep the ship comfortable in all climates. When used for heating, this plant extracts the heat from the sea—even in Arctic temperatures! The *Vidal* is fitted with the latest electronic aids and echo sounding gear. The latter enables those on board to receive a continuous and automatic trace of the sea-bed. There is also a large process camera and printing press, enabling the results of surveys to be printed on board. A twin screw ship, she is fitted with a new type of Diesel engine, designed by the Navy and known as the A.S.R.I., two of these being geared to each shaft. Her first survey was near the Isle of Man; when this was completed, she went to the Caribbean to start a much larger job there.

KEY TO PARTS

(1) Navigating bridge. (2) Saluting guns. (3) Echo sounding compartment. (4) C.O.'s day cabin. (5) Pantry. (6) Chart room. (7) Wheel house. (8) Sick bay. (9) Store. (10) Surveying chart room. (11) 27 ft. surf boat. (12) Survey motor-boat carried here. (13) Hangar. (14) Flight deck. (15) Seamen's mess. (16) Stokers' mess. (17) Printing room. (18) Photographic dark room. (19) Provisions. (20) Refrigerating machinery. (21) Cold store. (22) Crew's washplace. (23) Preparing room. (24) Crew's galley. (25) Crew's dining room. (26) Engine control. (27) Engineer's office. (28) Engineers' workshop. (29) Officers' accommodation. (30) Wardroom. (31) Low power room. (32) Engine rooms. (33) Danforth type anchor.



LAURENCE DUNN



The Whirlwind S55 type helicopter, one of which is carried aboard H.M.S. *Vidal*. This is used for aerial survey and transport of parties to shore observation stations.

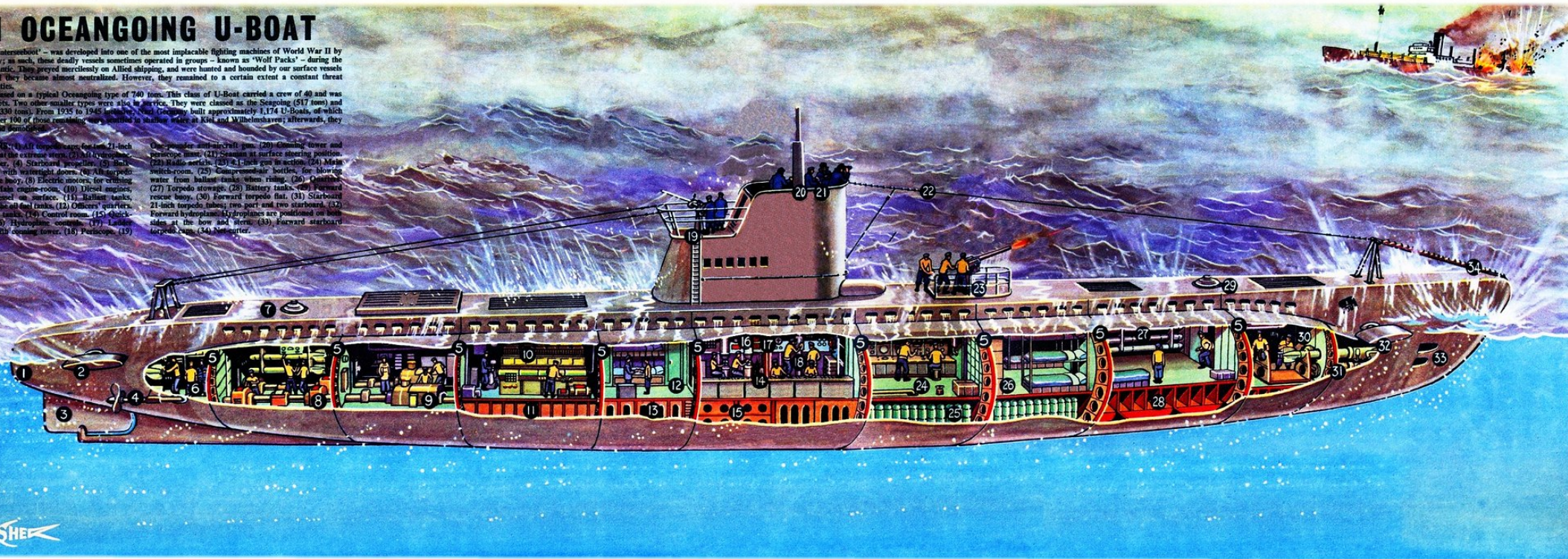
AN OCEANGOING U-BOAT

The U-Boat - 'Unterschoot' - was developed into one of the most implacable fighting machines of World War II by the German Navy; as such, these deadly vessels sometimes operated in groups - known as 'Wolf Packs' - during the Battle of the Atlantic. They preyed mercilessly on Allied shipping, and were hunted and hounded by our surface vessels and aircraft until they became almost neutralized. However, they remained to a certain extent a constant threat throughout hostilities.

Our drawing is based on a typical Ocean-going type of 740 tons. This class of U-Boat carried a crew of 40 and was capable of 16 knots. Two other smaller types were also in service. They were classed as the Seagoing (517 tons) and the Coastal (250/330 tons). From 1935 to 1945 however, the Germans built approximately 1,174 U-Boats, of which 785 were lost. Over 100 of those remaining were scuttled in shallow water at Kiel and Wilhelmshaven; afterwards, they were re-floated and dismantled.

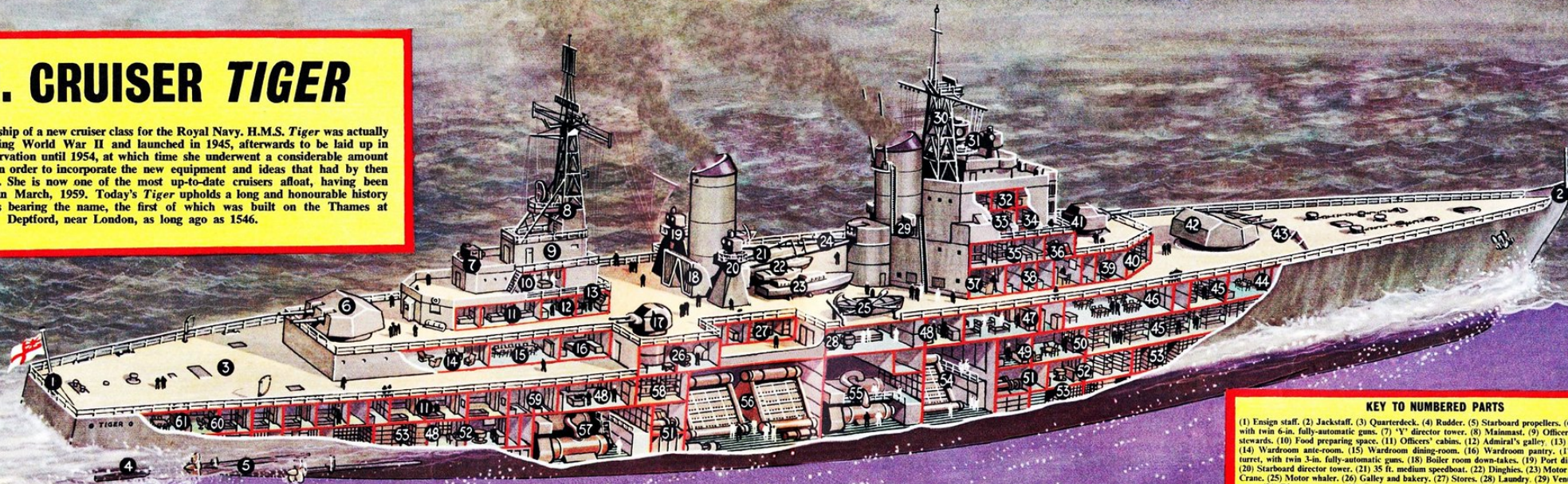
KEY TO NUMBERS: (1) Air torpedo escape for two 21-inch torpedoes located at the extreme stern. (2) Air hydroplane. (3) Vertical rudder. (4) Starboard propeller. (5) Ballast tanks, each fitted with watertight doors. (6) Air torpedo flat. (7) Air rescue boat. (8) Electric motors for cruising submerged. (9) Main engine-room. (10) Diesel engines for propelling vessel on surface. (11) Ballast tanks, behind which are the oil fuel tanks. (12) Officers' quarters. (13) Main ballast tanks. (14) Control room. (15) Quick-diving tanks. (16) Hydroplane controls. (17) Ladder communicating with conning tower. (18) Periscope. (19)

One-pounder anti-aircraft gun. (20) Conning tower and periscope mast. (21) Seaman at surface steering position. (22) Radio switch. (23) 4.1-inch gun in action. (24) Main switch-room. (25) Compressed-air bottles, for blowing water from ballast tanks when rising. (26) Quarters. (27) Torpedo stowage. (28) Battery tanks. (29) Forward rescue barge. (30) Forward torpedo flat. (31) Starboard 21-inch torpedo tubes; two port and two starboard. (32) Forward hydroplane. Hydroplanes are positioned on both sides at the bow and stern. (33) Forward starboard torpedo cage. (34) Net cutter.



H.M. CRUISER *TIGER*

This is the first ship of a new cruiser class for the Royal Navy. H.M.S. *Tiger* was actually laid down during World War II and launched in 1945, afterwards to be laid up in a state of preservation until 1954, at which time she underwent a considerable amount of re-planning in order to incorporate the new equipment and ideas that had by then been developed. She is now one of the most up-to-date cruisers afloat, having been commissioned in March, 1959. Today's *Tiger* upholds a long and honourable history of British ships bearing the name, the first of which was built on the Thames at Deptford, near London, as long ago as 1546.



KEY TO NUMBERED PARTS

(1) Ensign staff. (2) Jackstaff. (3) Quarterdeck. (4) Rudder. (5) Starboard propellers. (6) 'Y' turret, with twin 6-in. fully-automatic guns. (7) 'Y' director tower. (8) Mainmast. (9) Officers' cooks and stewards. (10) Food preparing space. (11) Officers' cabins. (12) Admiral's galley. (13) Radio room. (14) Wardroom ante-room. (15) Wardroom dining-room. (16) Wardroom pantry. (17) Starboard turret, with twin 3-in. fully-automatic guns. (18) Boiler room down-takes. (19) Port director tower. (20) Starboard director tower. (21) 35 ft. medium speedboat. (22) Dinghies. (23) Motor pinnace. (24) Crane. (25) Motor whaler. (26) Galley and bakery. (27) Stores. (28) Laundry. (29) Vents. (30) Foremast. (31) Director towers. (32) Gunner control stations. (33) Wireless room. (34) Sea cabins. (35) C.P.Os' mess. (36) Fans. (37) P.Os' mess. (38) C.P.Os' baths. (39) Entrance. (40) Messdeck. (41) Forward turret, with twin 3-in. fully-automatic guns. (42) 'A' turret, with twin 6-in. fully-automatic guns. (43) Breakwater. (44) Writers' messdeck. (45) Seamen's messdecks. (46) Junior ratings' dining-hall. (47) Sick bay. (48) Offices. (49) Baths. (50) Recreation space. (51) Auxiliary machinery. (52) Gyro rooms. (53) Stores. (54) Forward boiler room. (55) Forward starboard turbines. (56) After boiler room. (57) After starboard turbines; largely automatic, and can be remotely controlled. (58) Engineer mechanics' mess. (59) Officers' baths. (60) Captain's quarters. (61) Admiral's quarters.



HARDY'S DRAWING BOARD

STOLPORT~ An Airfield For The Oilfields

One of Britain's leading technical artists presents a weekly look at the world of science and technology.



THE PRESENT SYSTEM USED TO TRANSPORT MEN TO AND FROM OILFIELDS OUT AT SEA IS TO FLY THEM FIRST TO A COASTAL AIRFIELD THEN ON BY HELICOPTER TO THE RIG OR PLATFORM. AN ALTERNATIVE IS THE **SEAFORTH STOLPORT**, PROPOSED BY THE ABERDEEN-BASED SEAFORTH MARITIME COMPANY (RIGHT) ▶

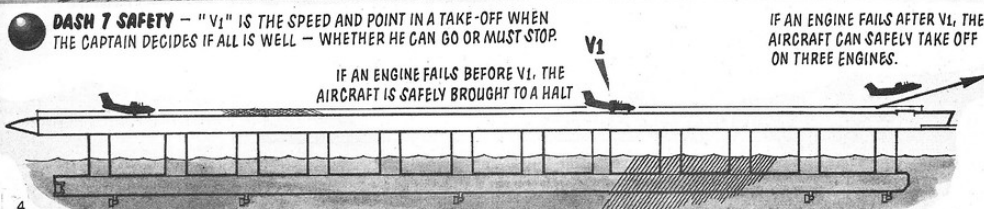


A STOLPORT OPERATING IN AN OILFIELD COULD PROVIDE THESE IMPORTANT SERVICES ON A LARGE SCALE

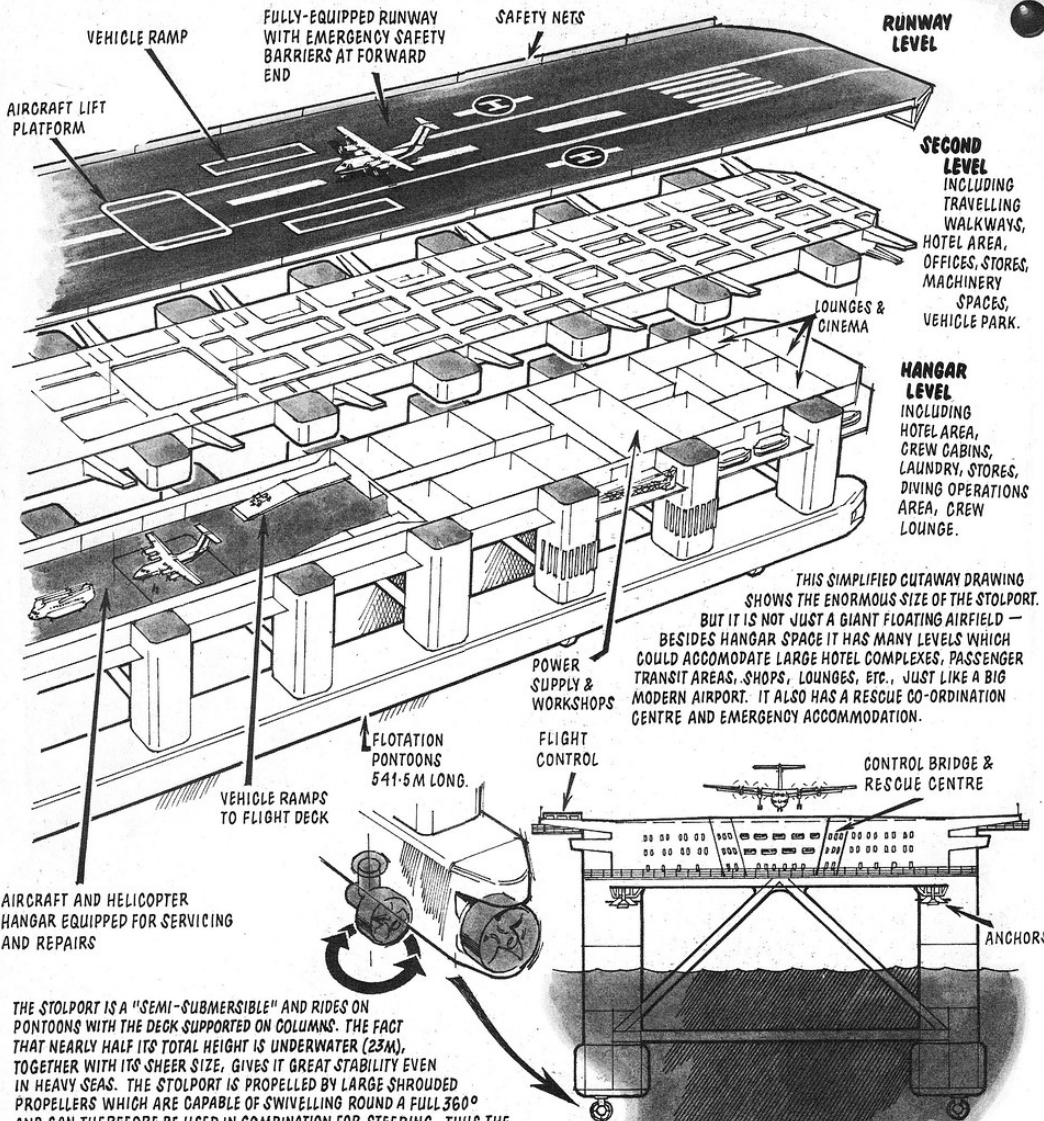


de HAVILLAND CANADA DASH 7

THE "STOL" IN STOLPORT STANDS FOR **SHORT TAKE-OFF AND LANDING** — A TERM USED TO DESCRIBE AIRCRAFT DESIGNED TO OPERATE FROM SHORT RUNWAYS. de HAVILLAND CANADA ARE EXPERTS IN THIS FIELD AND THEIR "DASH 7" IS IDEAL FOR FLYING OILMEN OUT TO A FLOATING RUNWAY. IT CARRIES FIFTY PASSENGERS. THIS EXCEPTIONALLY QUIET AND CAPABLE AIRCRAFT HAS SAFETY CHARACTERISTICS OF A HIGH ORDER (SHOWN IN THE DIAGRAM BELOW). THE STOLPORT RUNWAY FROM WHICH IT WOULD OPERATE WOULD BE FULLY-EQUIPPED WITH A HIGH-FRICTION (FIRM GRIP) DE-ICING SURFACE, AND HIGH-INTENSITY LIGHTING COUPLED WITH VERY CLEAR RUNWAY MARKINGS.



STOLPORT DIMENSIONS:
LENGTH OVER RUNWAY — 602M
WIDTH OVER RUNWAY — 90M
OVERALL HEIGHT TO RUNWAY — 51M



THE STOLPORT IS A "SEMI-SUBMERSIBLE" AND RIDES ON PONTOONS WITH THE DECK SUPPORTED ON COLUMNS. THE FACT THAT NEARLY HALF ITS TOTAL HEIGHT IS UNDERWATER (23M), TOGETHER WITH ITS SHEER SIZE, GIVES IT GREAT STABILITY EVEN IN HEAVY SEAS. THE STOLPORT IS PROPELLED BY LARGE SHROUDED PROPELLERS WHICH ARE CAPABLE OF SWIVELLING ROUND A FULL 360° AND CAN THEREFORE BE USED IN COMBINATION FOR STEERING. THUS THE STOLPORT CAN EASILY AND QUICKLY TURN INTO THE WIND FOR AIRCRAFT TO TAKE-OFF OR LAND — AND CAN MOVE QUICKLY OUT OF A FOG BANK TO KEEP CLEAR FLYING WEATHER.

THE STOLPORT IS BEING CLOSELY EXAMINED FOR USE IN U.K., CANADIAN AND NORWEGIAN WATERS. OTHER POTENTIAL AREAS INCLUDE THE GULF OF MEXICO, ARGENTINA AND OFF WESTERN AUSTRALIA.

MANY THANKS TO SEAFORTH FOR SUPPLYING INFORMATION FOR THIS "DRAWING BOARD"

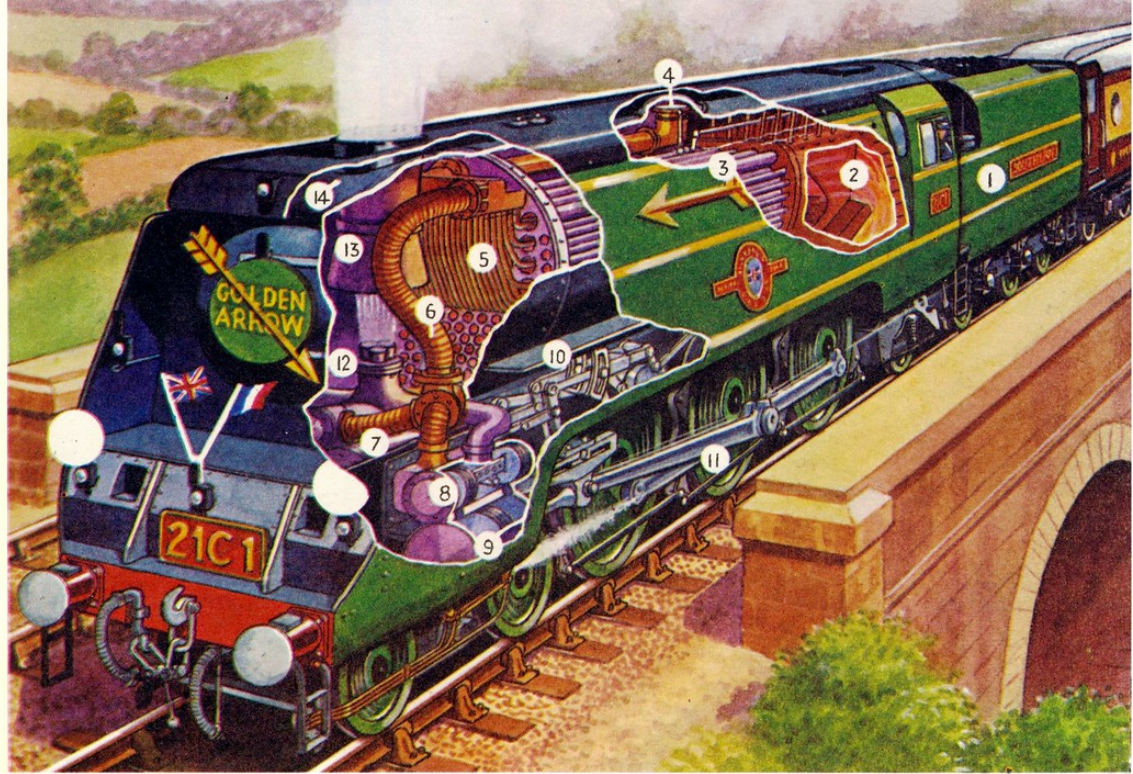
Seaforth Maritime
NEWSNEWSNEWS
Newspaper of Seaforth Maritime Limited. Issue no. 22

In less than a decade Seaforth has from what it is today. It is probably

EXPRESS TO THE CHANNEL COAST

A WORLD - FAMOUS train the "Golden Arrow" leaves Victoria Station, London, every day on its 95 minute dash to Dover, where passengers embark on the cross-channel ship for Calais and thence to Paris. The train was hauled by one of the Merchant Navy class steam locomotives of the Southern Railway. These "air-smoothed" engines were all named after famous shipping companies, they had a strange number system of the S.R. which denoted the wheel arrangement and engine number. "Channel Packet" 21C1, was the first of the class to be built, the number was later changed to 35001. The 3-cylinder design was unusual in having chain driven piston valve motion gear encased in an oil bath. These engines had all-electric lighting.

KEY TO NUMBERED PARTS
(1) Water capacity, 5,000 gallons. Coal, 5 tons. (2) Fire box with brick arch and water circulators. (3) Fire tubes and superheater tubes. (4) Steam dome and driver's regulator valve - steam pipe to superheater. (5) Superheater header. (6) Superheated steam pipe to outside and inside cylinders. (7) Inside cylinder drives the middle driving wheel axle. (8) Special type piston valves with rocker action. (9) Outside cylinder. (10) Piston valve motion gear for all three cylinders totally encased in an oil bath. (11) Connecting rod and coupling rod of driving wheels. (12) Exhaust blast pipe. (13) Chimney exhaust cowl. (14) Streamlined outer casing and "air-smoothed" opening - this lifts exhaust upwards.

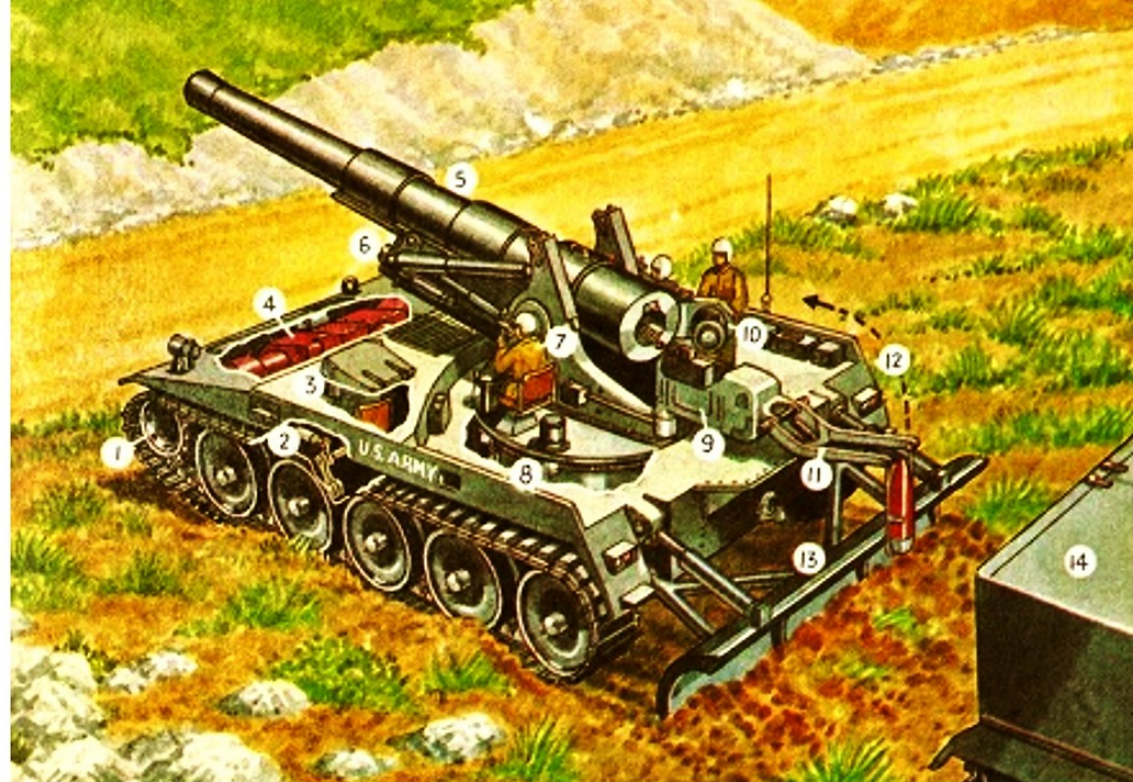


"GOLDEN ARROW"

SELF-PROPELLED BIG GUN

POPULARLY known as the atomic cannon, the American T.236 is a 203-mm. gun mounted on a tracked vehicle. Instead of towing guns behind lorries, more and more artillery are now becoming self-propelled under their own power. Apart from firing 200-lb. high-explosive shells, this gun can also fire the U.S. 8-in. atomic shell with a range of 10 miles. A unique feature is the shell-loading tray, with swinging arms over the back of the vehicle. Crew members put a shell on these arms which then swing right over and down on to the loading tray, where a ram puts it into the breach. The tray and arms are moved aside on a pivot when the gun is fired. An hydraulic spade, at the back, digs into the ground and takes the enormous recoil.

KEY TO NUMBERED PARTS
(1) Track-drive sprocket wheel. (2) Track-wheel suspension. (3) Driver's hatch and periscopes. (4) General Motors 420-h.p. 8-cylinder diesel engine and track-drive gearbox. (5) 203-mm. (8 in.) calibre gun barrel. (6) Recoil mechanism. (7) Gun layer's seat and telescopic sights. (8) Turntable with gun-mount operated by electric motors. (9) Shell-loading tray and ram. (10) Breach block (open). (11) Shell-loading arms - these are operated from a control panel by the officer in charge of the gun. (12) Loading arms, with shell, swing right over to the loading tray. (13) Recoil spade in "digging-in" position. (14) Track-driven ammunition carrier.

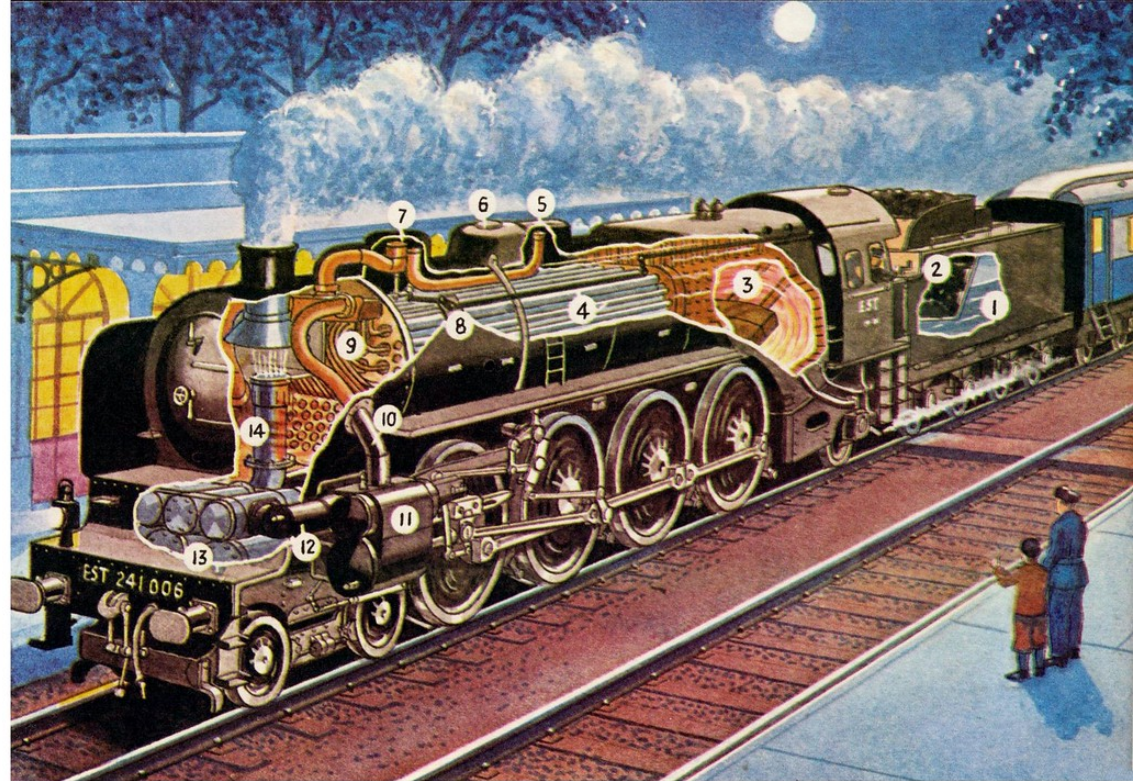


U.S. GUN CARRIER

THE GATE-WAY TO EUROPE

THE "Orient Express" was one of the most famous trains in Europe. It ran from Paris right across Europe, passing through France, Germany, Austria, Hungary and Roumania. The French section was the Eastern Railway from Paris to Strasbourg, a distance of 312 miles. Some fine express locomotives were used on this route, notably the famous 4-cylinder compound 4-8-2 Mountain type shown here. Compound locomotives are ones in which the steam, after being used in the outside high-pressure cylinders, is taken to the larger inside low-pressure cylinders for further expansion before passing to exhaust. Engine and tender weighed 187 tons 2 cwt in working order, an 8-wheeled, double-bogie tender was used with these engines for long-distance non-stop runs.

KEY TO NUMBERED PARTS
(1) Water capacity 7,700 gallons. (2) Coal, 8 tons. (3) Fire box with brick arch and water circulating pipes. (4) Fire tubes and superheater tubes. (5) Steam rises to rear steam dome and passes to front steam dome. (6) Sand supply dome. (7) Front steam dome and supply to superheater. (8) Driver's regulator valve. (9) Superheater header. (10) Superheated steam pipe to outside cylinder. (11) High-pressure cylinder drives the second pair of driving wheels. (12) Exhaust from high-pressure cylinder to the larger low-pressure inside cylinder (both sides). (13) Inside cylinders drive the first pair of driving wheels. (14) Exhaust blast pipe from inside cylinders.

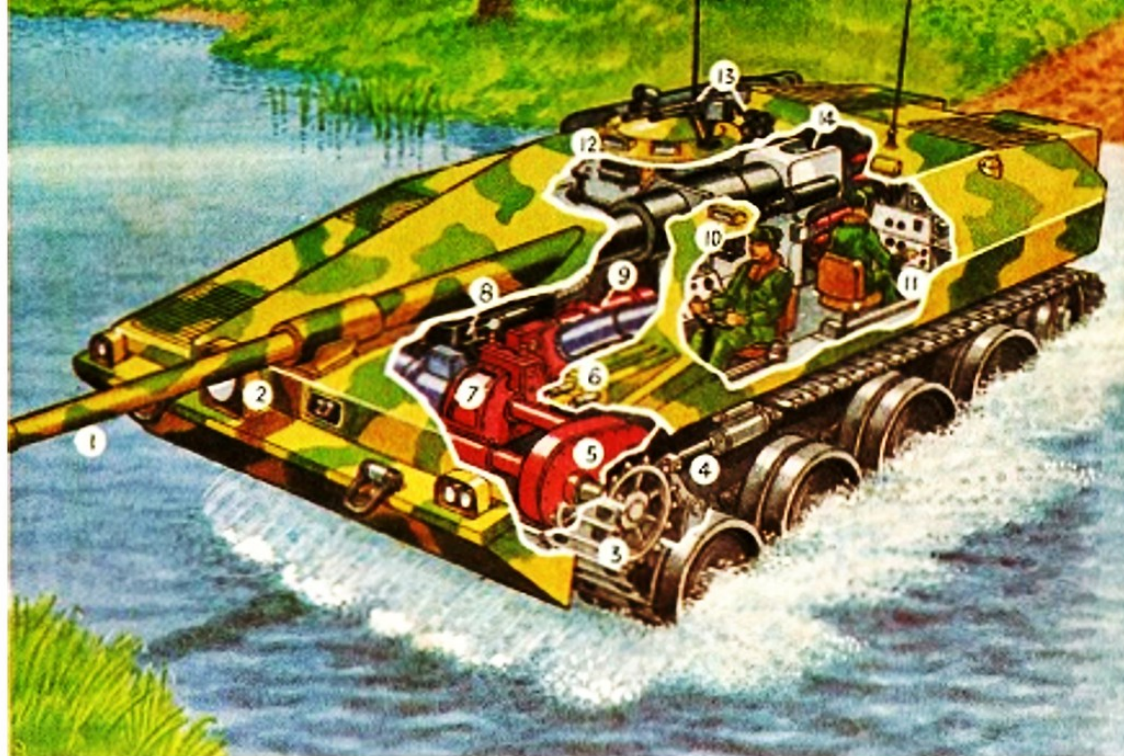


"ORIENT EXPRESS"

A FIXED GUN VEHICLE

THE term "tank", when applied to a military vehicle, usually means that its gun and turret can rotate through an arc of 360° (full circle), even when on the move. If the gun is fixed in the hull or body, the vehicle is known as a "self-propelled gun". The Swedish "S" Tank is a most original design to carry a gun into action; the British 105-mm. gun is fixed rigidly in the hull so that the whole vehicle has to be aimed at the target. Elevation is achieved by raising the front of the body on its own suspension. This tank has an unique power combination of a Rolls-Royce multi-fuel engine and an American jet engine. Details are: Length with gun, 28 ft. 8 in.; width, 10 ft. 9 in. Armament: 105-mm. gun; three 7-62-mm. machine-guns.

KEY TO NUMBERED PARTS
(1) British 105-mm. fixed gun. (2) Searchlight. (3) Track-drive sprocket wheel. (4) Suspension system is used to elevate gun solely by raising the front of the whole vehicle. (5) Final drive reduction gears. (6) Two fixed 7-62-mm. machine-guns. (7) Gearbox and track-steering clutches and brakes. (8) 240-h.p. Rolls-Royce K.60 multi-fuel engine – can use either diesel oil, petrol or kerosene. (9) 330-h.p. American Boeing 502 jet engine – both engines are coupled together. (10) Driver-gunner and periscope. (11) Radio operator-engineer. (12) Commander's hatch. (13) 7-62-mm. machine-gun and smoke-grenade dischargers. (14) Vertical moving breach of automatic-loading gun.

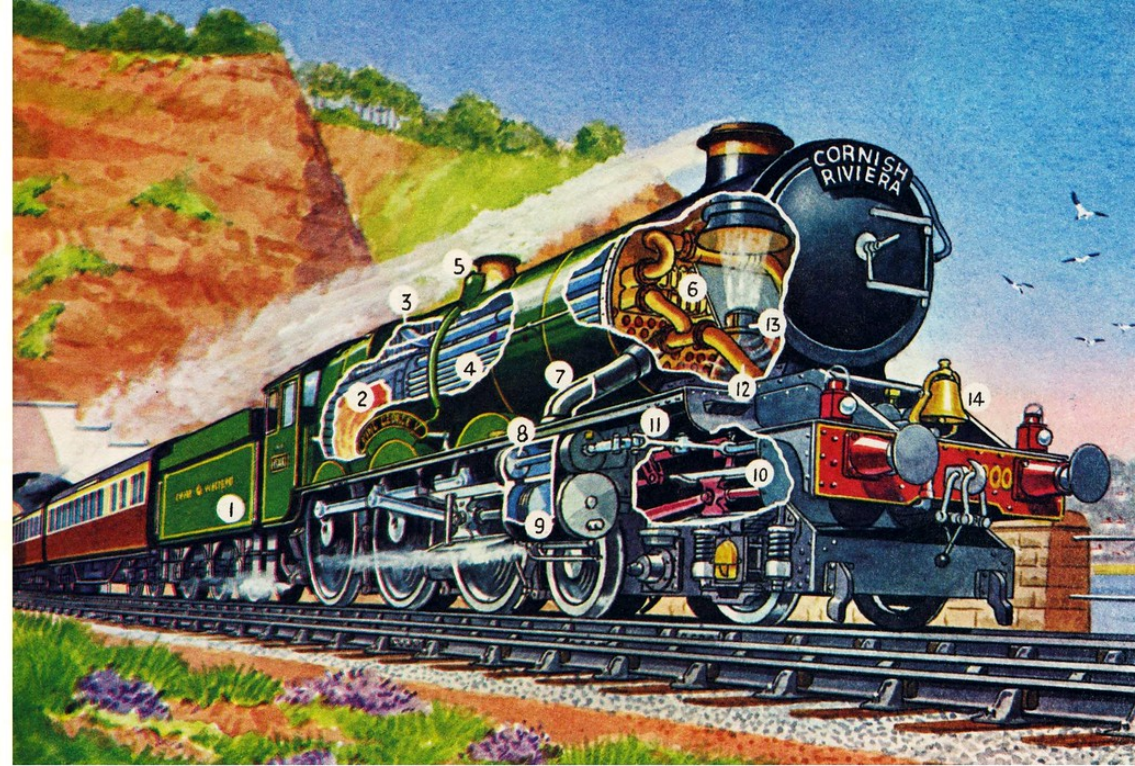


SWEDISH "S" TANK

ALONG THE SEA SHORE

FOR many years, under steam power, the "Cornish Riviera Limited" was a world famous train. It started from Paddington Station, London, every day at 10.30 a.m. on the dot, on its 305 miles run to Penzance, Cornwall, covering the distance to Plymouth, 226 miles, non-stop. The steam locomotives to haul this train were the famous "King" class of the Great Western Railway. "King George V", No. 6000, is here seen passing along the sea shore at Dawlish, Devon. This engine was exhibited in America in 1927 and was presented with an American locomotive bell. The 4-cylinder 4-6-0 "King" class were handsome engines with their 6 ft. 6 in. driving wheels, they were 68 ft. 2 in. long and weighed with tender 135 tons 14 cwt. in working order. Steam pressure was 256 lb. per square inch.

KEY TO NUMBERED PARTS
(1) Tender water capacity 4,000 gallons. Coal, 6 tons. (2) Fire box with brick arch. (3) Steam entry and supply pipe to driver's regulator valve at front of boiler. (4) Fire tubes and superheater tubes. (5) Safety valve casing and water feed valves to boiler. (6) Superheater header. (7) Steam pipe from superheater to outside cylinder. (8) Piston valves. (9) Piston with connecting rod drive to middle pair of driving wheels. (10) Inside cylinder block drives the leading pair of driving wheels. (11) Rocker arm motion to outside piston valves. (12) Steam pipe from superheater to inside cylinder. (13) Exhaust blast pipe from all four cylinders. (14) The American locomotive bell.



"CORNISH RIVIERA LIMITED"

THROUGH THE CANADIAN ROCKIES

THE crack trans-continental express of the Canadian National Railways is the "Continental Limited" which operates daily between Montreal and Vancouver. On its 2,929 miles run, this all-steel train passes through the Yellowhead Pass in the Rocky Mountains. In the days of steam this train was hauled by one of the "6400" class locomotives with 4-8-4 wheel arrangement. These semi-streamlined giants were 95 ft. long and weighed 290 tons in running trim, the cylindrical shape tender was carried on 12 wheels. There were no water pick-up troughs on this line so the tender carried 11,700 gallons, to last between long runs before refilling. A steam driven mechanical screw stoker fed the huge fire box with coal. Boiler pressure was 275 lb. per square inch.

KEY TO NUMBERED PARTS

(1) Tender coal capacity, 20 tons. (2) Water capacity, 11,700 gallons. (3) Mechanical screw stoker. (4) Fire box and brick arch. (5) Fire tubes and superheater tubes. (6) Steam dome and supply pipe to superheater header. (7) Sand supply dome – sand is used to prevent wheel-slip. (8) Driver's regulator valve. (9) Superheater elements to and from boiler. (10) Superheated steam pipe to outside cylinder (both sides). (11) Piston valve chest. (12) Outside cylinder – the two huge cylinders had a bore of 24 in. and a stroke of 30 in. (13) Exhaust blast pipe. (14) Air inlet grill in streamlined top casing – the air flow round the chimney forces exhaust steam and smoke upwards.



"CONTINENTAL LIMITED"

ATOMIC STEAM ENGINE

Research is in progress on both sides of the Atlantic for an atomic reactor suitable for railway engines. Indeed, plans have already been drawn up in the U.S. for an atomic locomotive, and we show here our artist's impression of the form this may take. The system used is atomic-steam-turbine-electric. The enormous heat generated in an atomic reactor - by the fission of Uranium 235 - turns water into steam in a heat exchanger. This superheated steam drives a normal type of turbine which, in turn, drives a generator. The generator supplies an electric current to six traction motors geared to the wheels of the locomotive.

A locomotive of this type could travel many thousands of miles without refuelling, except for water, and, as the locomotive is a self-contained unit, costly and ugly overhead electric traction wire is not needed - nor are power stations to supply the electricity!

Once the problem of shielding an atomic pile against harmful radiation has been solved, locomotives of this type could put steam power back on to the railways of the world!

The atomic reactor is the heart of the machine. Here, Uranium 235 atoms are exploded by neutrons, thus generating great heat which is used to produce superheated steam.

AN EAGLE
cutaway
DRAWING

KEY TO NUMBERED PARTS

(1) Electric power and brake connections. (2) Compressed air reservoir for brakes. (3) Light, streamlined casing on aircraft construction principle. (4) Driver's control console. All operations centralized. (5) Air-brake cylinders. (6) Six-wheeled bogie with three traction motors. (7) Reduction gearing. (8) Traction motor. (9) Cooling air blower for traction motors. (10) Main generator. (11) Auxiliary generator for services, lighting, etc. (12) Generator cooling air duct. (13) Turbine exhaust duct. (14) Three-stage steam turbine driving generator. (15) Turbine steam control nozzles. (16) Steam valve. (17) Nozzle control. (18) Auxiliary water supply tanks. (19) Main water supply to heat exchanger. (20) Circulating pump for hot gases between reactor and heat exchanger. (21) Two heat exchangers. Here the incoming water is turned into superheated steam. (22) Steam pipes to turbine. (23) Atomic reactor. (24) Control rods. (25) Heavy shielding against radiation. (26) Outer shielding. (27) Six-wheeled bogie with three traction motors. (28) Water supply. (29) Compressed air reservoir for brakes.

ASHWELL
WOOD

£10,000 Worth Of Prizes To Be Won — See Inside

Look AND Learn

No. 1,001, 16th MAY, 1981, EVERY MONDAY PRICE 40p.

The One-Man Supersub

SEE 'HARDY'S DRAWING BOARD' — Page 4



With WORLD OF KNOWLEDGE



HARDY'S DRAWING BOARD

The One-Man Supersub

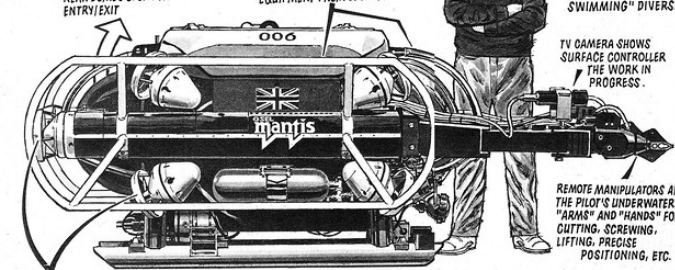
The latest designs in small submersibles may enable man to work at depths previously thought totally impractical



WORKING UNDERWATER HAS ALWAYS BEEN A HAZARDOUS BUSINESS — THE DEEPER ONE GOES, THE MORE DIFFICULT IT GETS. FOR APPROXIMATELY EVERY NINE METRES OF DESCENT THE PRESSURE DOUBLES. THE DIVING DEVICE DESIGNED BY JOHN LETHBRIDGE IN 1715 (ABOVE, LEFT) COULD GO TO ABOUT 18M — THE MODERN OFFSHORE-OIL DIVER MUST DESCEND TO OVER 400M. HE BREATHES A SPECIAL GAS MIXTURE BEFOREHAND TO ACCLIMATISE TO THE PRESSURE. THEN TAKES DAYS AFTERWARDS IN A DECOMPRESSION CHAMBER TO RETURN TO NORMAL. ONE ALTERNATIVE IS THE **MANTIS** — THE WORLD'S SMALLEST SUB.

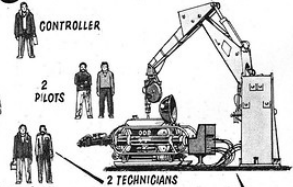
REAR DOMES OPEN FOR ENTRY/EXIT

FRAMES PROTECT SUB'S STRUCTURE. EQUIPMENT FROM DAMAGE



ELECTRICALLY-POWERED THRUSTERS WITH TWO-BLADE PROPELLERS ENABLE THE MANTIS TO TURN IN ANY DIRECTION.

TECHNICALLY THE MANTIS IS A "TETHERED SUBMERSIBLE" — A SUB ON A CABLE. THE PILOT BREATHES OXYGEN AT NORMAL PRESSURE WHILE WORKING IN A "SHIRT-SLEEVE" ENVIRONMENT. THE SAFETY AND BACK-UP SYSTEMS HAVE BEEN DESIGNED WITH GREAT CARE, SO IF SOMETHING SHOULD GO WRONG HAS OXYGEN FOR 72 HOURS — TIME FOR HELP TO ARRIVE.



CONTROLLER

2 PILOTS

2 TECHNICIANS

MANTIS MOUNTED ON ITS LOWERING/RAISING ARM. LINKED EQUIPMENT INCLUDES A CONTROL SHACK WITH TV MONITOR, THE CABLE WINCH AND ELECTRICAL POWER PACK. FAR MORE MEN AND EQUIPMENT ARE NEEDED FOR "FREE-SWIMMING" DIVERS.

TV CAMERA SHOWS SURFACE CONTROLLER THE WORK IN PROGRESS.

REMOTE MANIPULATORS ARE THE PILOT'S UNDERWATER "ARMS" AND "HANDS" FOR CUTTING, SCREWING, LIFTING, PRECISE POSITIONING, ETC.

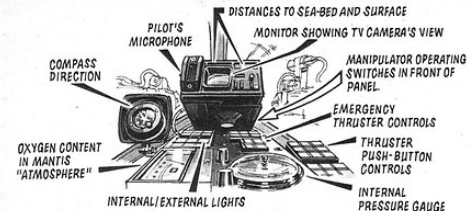
THE MANTIS HAS ALREADY DEMONSTRATED ITS VERSATILITY. IT HAS BEEN USED FOR AIRCRAFT WRECKAGE RECOVERY, PLACING EXPLOSIVE CHARGES, CUTTING AND REMOVING CABLES, AND WORK CONNECTED WITH THE UNDERWATER UNITS USED IN THE OIL AND GAS INDUSTRY.

OSEL'S FIRST SUBMERSIBLE DESIGN WAS THE "WASP", HENCE THE SYMBOL!

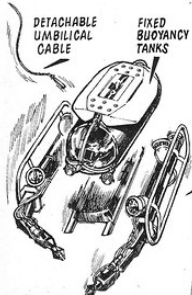


OSEL GROUP

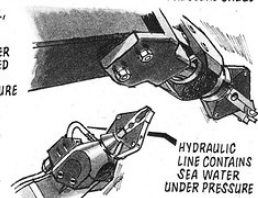
MANY THANKS TO OFFSHORE SYSTEMS ENGINEERING LTD., GREAT YARMOUTH, FOR "MANTIS" AND "HAWK" INFORMATION.



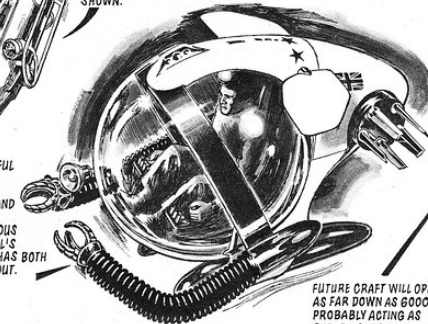
ABOVE, THE PILOT'S WORKING PANEL, AND, RIGHT, THE MANIPULATORS. THEY ARE POWERED BY HYDRAULIC FLUID (WHICH IS, IN FACT, SEA WATER UNDER PRESSURE) AND HAVE PROVED VERY EFFICIENT. AFTER A LITTLE PRACTICE IT BECOMES SECOND NATURE FOR THE PILOT TO USE THEM. MANY DIFFERENT HEADS CAN BE ATTACHED FOR SPECIAL TASKS.



THE NEXT STEP IS TO PRODUCE MORE POWERFUL THRUSTERS TO ALLOW SUBMERSIBLES TO MANOEUVRE QUICKLY AND NIMBLY. AND MORE POWERFUL AND DEXTEROUS MANIPULATORS — OSEL'S NEW "HAWK" DESIGN HAS BOTH IN ITS FUTURISTIC LAYOUT.

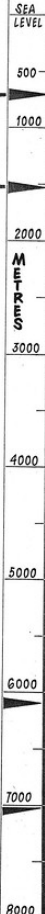


SHOULD ANY EMERGENCY MAKE IT NECESSARY, THE MANTIS PILOT CAN DETACH ANY OF HIS SIDE OR LOWER UNITS (FOR INSTANCE, IF A MANIPULATOR BECOMES TRAPPED). HERE, FOR CLARITY, ALL THE DETACHABLE SECTIONS ARE SHOWN.

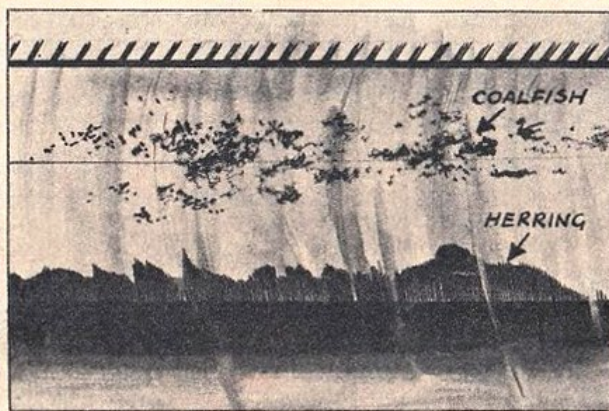
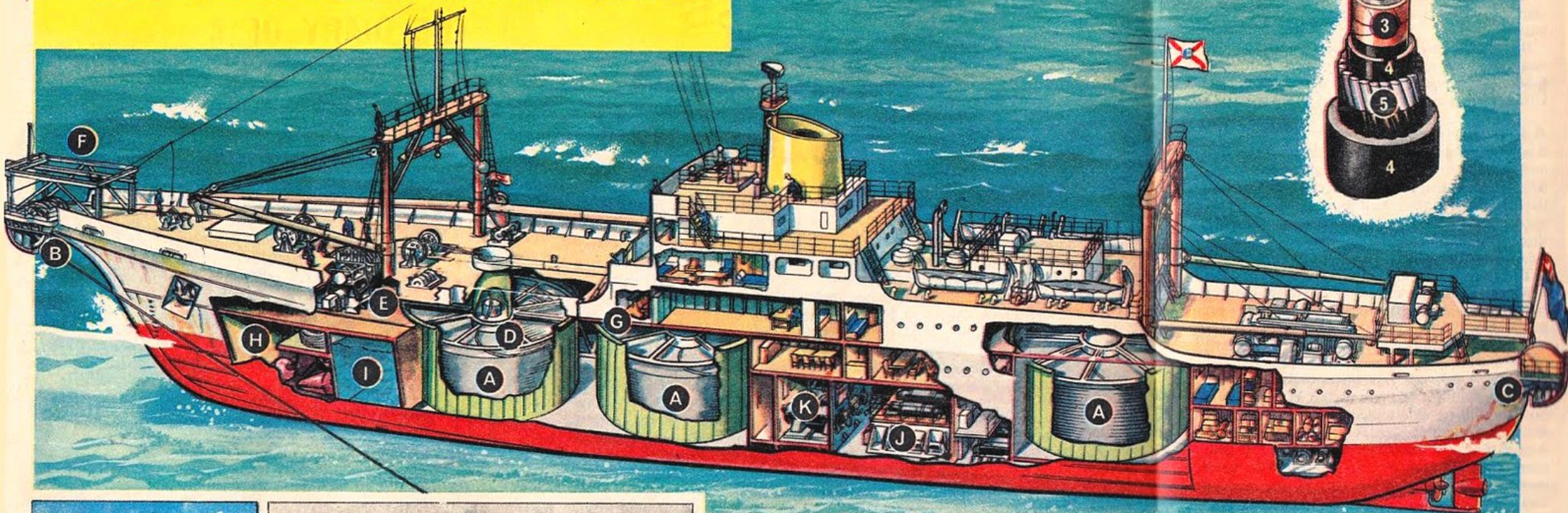


FUTURE CRAFT WILL OPERATE AS FAR DOWN AS 6000M +, PROBABLY ACTING AS SUPERVISORS FOR ROBOT WORKING SUBS.

* UNDERWATER THE SUB IS BUOYANT AND DOES NOT "HANG" ON THE CABLE.



SIGNALS UNDER THE SEA



TELEPHONE CABLES

World communications largely depend upon cables laid along the bottom of the oceans, linking the continents together. Undersea telephone cables are laid, picked up and repaired by special ships such as the one shown here. Cable is stored in tanks (A) and paid out over bow (B) and stern (C) sheaves by way of 'crinolines' (D) and cable engines (E). Other features of the ship are: (F) lifting gantry for handling cable repeaters, (G) drum room for controlling the cable, (H) forward hold for stowage, (I) fuel and fresh water tanks, (J) main engine room, (K) boiler room. At top right is a section through a submarine cable: (1) solid copper conductor, (2) polythene insulation, (3) copper binding and return conductor tapes, (4) inner and tarred outer jute servings, (5) galvanised steel wire armour.

THE ECHO SOUNDER

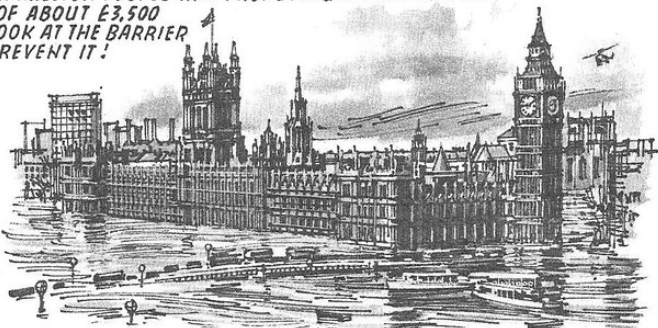
The bottom left-hand drawing illustrates a device known as the echo sounder, which is often used by modern fishing trawlers to tell the skipper the depth of water below him. It sends out short pulses of sound from a transmitter in the ship's bottom (X) which is reflected from the seabed (Y) and picked up by the ship's receiver (Z), the time interval indicating the depth of water. An instrument on board the ship produces a continuous paper record chart of the bottom in the form shown in the second panel, which includes the skipper's pencilled notes indicating the presence of shoals of fish.

One of Britain's leading technical artists presents a weekly look at the world of science and technology

HARDY'S DRAWING BOARD

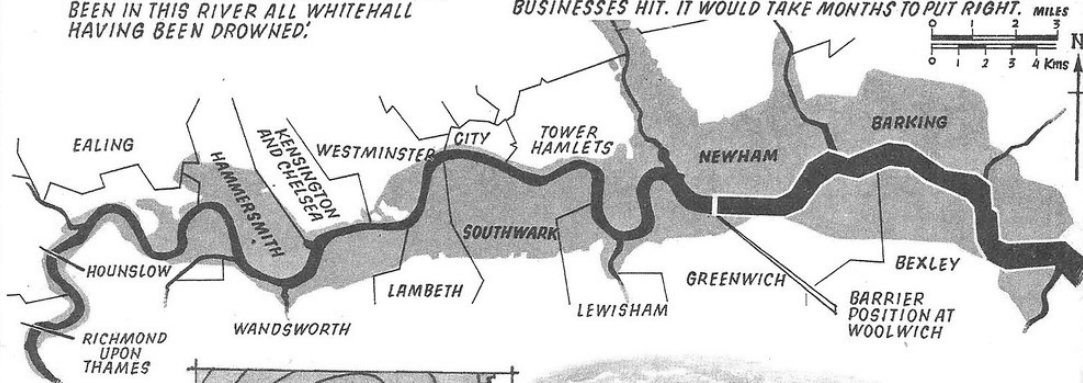
Taming The Thames

A RARE BUT POSSIBLE COMBINATION OF WIND, WEATHER AND TIDE COULD CAUSE THE RIVER THAMES TO FLOOD LONDON, AFFECTING THE LIVES OF MORE THAN A MILLION PEOPLE AND PRODUCING AN ESTIMATED DAMAGE BILL OF ABOUT £3,500 MILLION. WE LOOK AT THE BARRIER DESIGNED TO PREVENT IT!

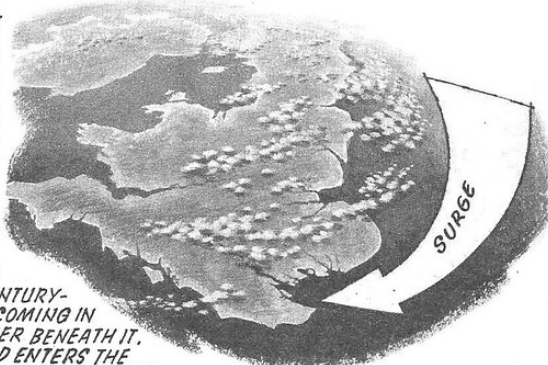
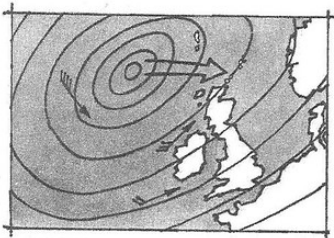


IN HIS DIARY FOR DECEMBER 7th 1663 SAMUEL PEPYS WROTE 'THERE WAS LAST NIGHT THE GREATEST TIDE THAT EVER WAS REMEMBERED IN ENGLAND TO HAVE BEEN IN THIS RIVER ALL WHITEHALL HAVING BEEN DROWNED'.

IF THE THAMES FLOODED LONDON TODAY, IT WOULD BE A CATASTROPHE OF HORRIFYING PROPORTIONS. THE CENTRAL PART OF THE UNDERGROUND RAILWAY WOULD BE PARALYSED, POWER, GAS AND WATER SUPPLIES, VITAL TELEPHONE AND TELEX LINKS CUT-THOUSANDS OF HOMES, OFFICES AND BUSINESSES HIT. IT WOULD TAKE MONTHS TO PUT RIGHT.

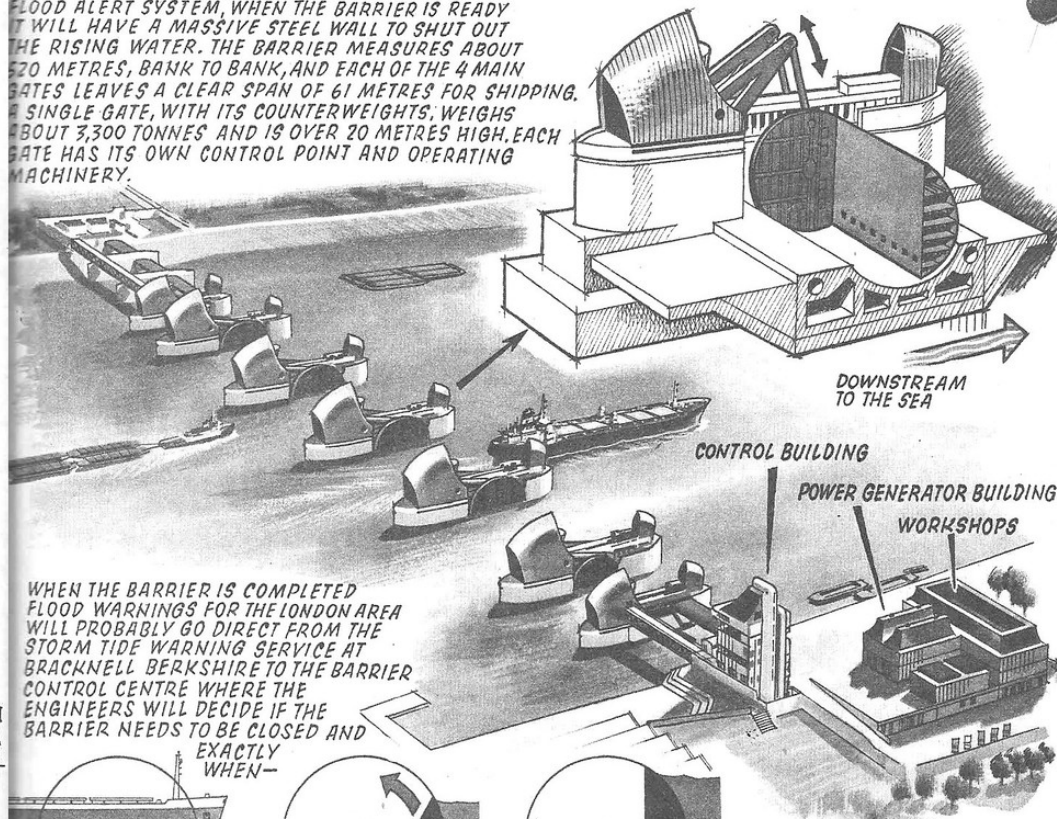


THE MAP ABOVE SHOWS THE AREA WHICH COULD BE FLOODED...

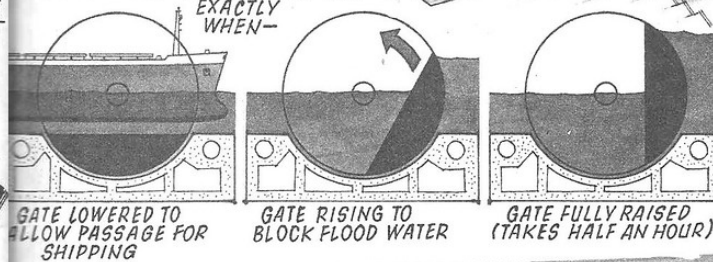


AND HERE'S HOW IT COULD HAPPEN. FOR A START, ON A VAST TIME SCALE, THE SOUTH-EAST OF BRITAIN IS SINKING AT THE RATE OF 0.36m PER CENTURY-NOW ADD THE WEATHER. A DEPRESSION (ABOVE) COMING IN FROM THE ATLANTIC CAUSES A "HUMP" OF WATER BENEATH IT. IF THIS HUMP COMES DOWN THE NORTH SEA AND ENTERS THE THAMES ESTUARY ON TOP OF A HIGH TIDE-THE FLOOD THREATENS.

LONDON TODAY HAS A HIGHLY ORGANISED FLOOD ALERT SYSTEM, WHEN THE BARRIER IS READY IT WILL HAVE A MASSIVE STEEL WALL TO SHUT OUT THE RISING WATER. THE BARRIER MEASURES ABOUT 520 METRES, BANK TO BANK, AND EACH OF THE 4 MAIN GATES LEAVES A CLEAR SPAN OF 61 METRES FOR SHIPPING. A SINGLE GATE, WITH ITS COUNTERWEIGHTS, WEIGHS ABOUT 3,300 TONNES AND IS OVER 20 METRES HIGH. EACH GATE HAS ITS OWN CONTROL POINT AND OPERATING MACHINERY.

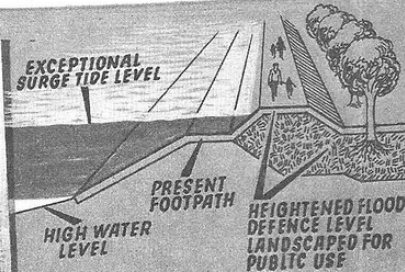
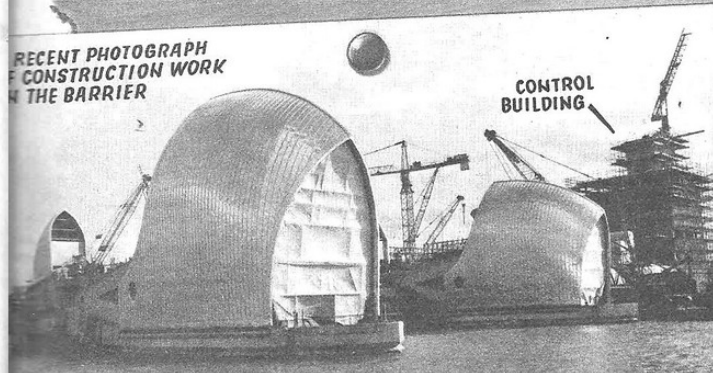


WHEN THE BARRIER IS COMPLETED FLOOD WARNINGS FOR THE LONDON AREA WILL PROBABLY GO DIRECT FROM THE STORM TIDE WARNING SERVICE AT BRACKNELL BERKSHIRE TO THE BARRIER CONTROL CENTRE WHERE THE ENGINEERS WILL DECIDE IF THE BARRIER NEEDS TO BE CLOSED AND EXACTLY WHEN-



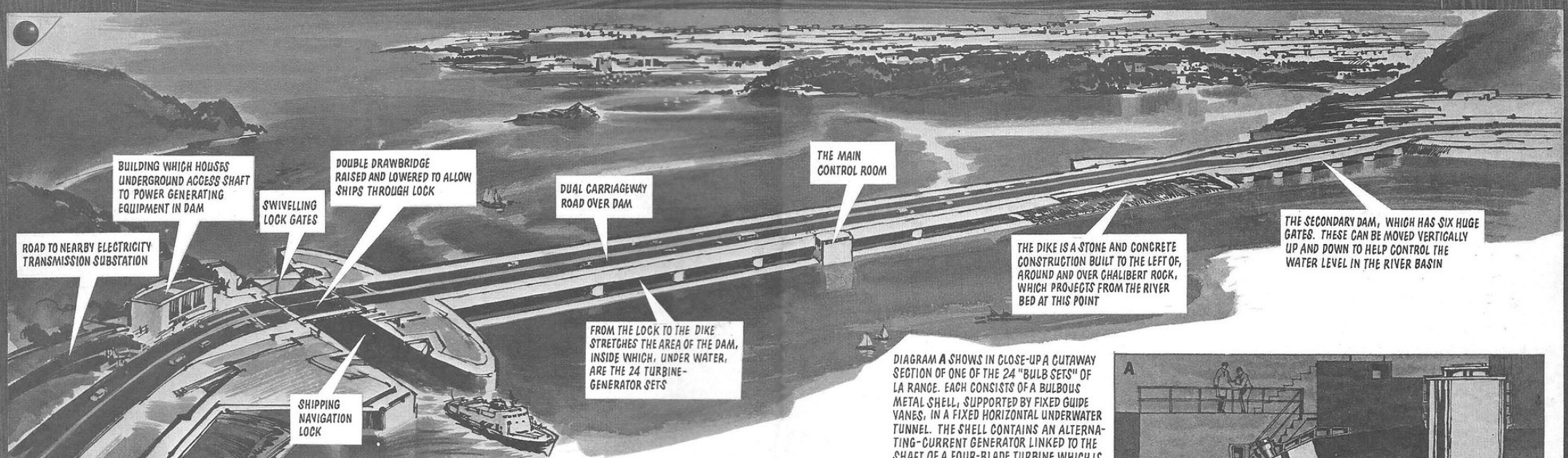
ABOVE IS AN AERIAL VIEW OF THE COMPLETED BARRIER AND ITS SHORE BUILDINGS LOOKING FROM ABOVE THE SOUTH BANK.

RECENT PHOTOGRAPH OF CONSTRUCTION WORK AT THE BARRIER



FLOOD DEFENCE LEVELS ALONG THE BANKS MUST BE RAISED TO ALLOW FOR WATER THE BARRIER WILL KEEP OUT

THANKS TO THE GLC FOR THE PHOTOGRAPH AND MUCH HELP



One of Britain's leading technical artists presents a weekly look at the world of science and technology

HARDY'S DRAWING BOARD

Power From The Sea



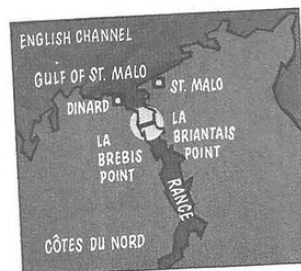
The Rance Power Dam in northern France has proved that the massive strength of the tides can be harnessed as a source of energy

SCHEMES FOR USING WATER POWER TO GENERATE ELECTRICITY ARE OFTEN SPECTACULAR, BUT FEW MORE SO THAN THE 750M WIDE DAM WHICH SITS ASTRIDE THE ESTUARY OF THE RIVER RANCE IN BRITAIN, ON THE NORTHERN COAST OF FRANCE. THE PROJECT, KNOWN SIMPLY AS **LA RANCE**, MAKES USE OF THE MASSIVE STRENGTH OF THE TIDES WHICH RUSH IN AND OUT OF THE WIDE MOUTH OF THE ESTUARY. THOUGH THEIR AVERAGE RISE AND FALL IS 11-4M THEY SOMETIMES RISE TO MORE THAN 13M, SENDING 170 MILLION CUBIC METRES OF TIDAL WATER RUSHING THROUGH THE RIVER'S MOUTH. SCHEMES WHICH USE RIVERS OPERATE BY FIRST DAMMING OFF THE FLOW OF RIVER WATER AND THEN RELEASING IT UNDER GREAT PRESSURE THROUGH PIPES TO SPIN THE BLADES OF TURBINES, WHICH IN TURN SPIN THE CURRENT GENERATORS. IN THE RANCE POWER DAM, THE PRESSURE IS PROVIDED BY FORCING THE TIDAL ESTUARY WATER THROUGH 24 TUNNELS IN WHICH ARE PLACED TURBINES AND GENERATORS.

THE TURBINES OPERATE IN TWO WAYS - TURNING AS THE TIDE RUSHES THROUGH INTO THE RIVER BASIN AND REVERSING THEIR DIRECTION AS IT RUSHES OUT AGAIN TO SEA. THE CONSTRUCTION OF THIS GIANT PROJECT PRESENTED THE ENGINEERS WITH PARTICULARLY DIFFICULT PROBLEMS. THEY HAD TO SHUT OFF AND PUMP DRY A WHOLE AREA, WORKING AGAINST THE FIERCE POWER OF THE VERY TIDES THEY WISHED TO HARNESS FOR GENERATING ELECTRICITY. TO DO THIS, THEY WENT TO HYDRAULIC RESEARCH SCIENTISTS WHO CONSTRUCTED ACCURATE LARGE SCALE MODELS OF THE ESTUARY AND USED SPECIAL EQUIPMENT TO SIMULATE THE TIDAL FLOWS. FROM THESE STUDIES, THE BUILDING METHOD WAS WORKED OUT. HUGE "COFFERDAMS" OR CYLINDERS WERE TOWED OUT AND SUNK ON TO THE RIVER BED UNTIL AN OVAL-SHAPED AREA WAS SEALED OFF AND COULD BE PUMPED DRY. INSIDE THE DOUBLE WALL OF COFFERDAMS, THE BUILDING WENT AHEAD.



THE POWER OF THE TIDES OF BRITAIN HAS BEEN KNOWN AND USED ON A SMALL SCALE FOR CENTURIES. THERE CAN STILL BE SEEN A FEW ANCIENT TIDAL MILLS WHICH USED WATER WHEELS POWERED BY TIDAL FLOW TO GRIND FLOUR. LIKE WINDMILLS AND WATER-MILLS, ONCE USED IN THOUSANDS, THEY ARE NOW ALMOST EXTINCT.



THE MAP SHOWS THE POSITION OF THE RANCE ESTUARY DAM. THERE IS A CONSIDERABLE FLOW OF ELECTRIC POWER ACROSS THE CHANNEL. FRANCE HAS ENORMOUS HYDRO-ELECTRIC POWER RESERVES WHICH BRITAIN, WHICH HAS TO RELY MAINLY ON THERMAL (COAL OR NUCLEAR) POWER STATIONS, IS ABLE TO DRAW ON.

BY 1967, LA RANCE WAS IN PARTIAL OPERATION PRODUCING 208 MILLION KILOWATTS PER HOUR. IT NOW PRODUCES ABOUT 500 MILLION KILOWATTS PER HOUR - ONE PER CENT OF TOTAL FRENCH POWER PRODUCTION. ALTHOUGH SCHEMES FOR SIMILAR BARRIERS ACROSS THE SEVERN ESTUARY IN BRITAIN AND ACROSS PASSAMAQUODDY BAY, BETWEEN MAINE, U.S.A., AND NEW BRUNSWICK, CANADA, HAVE BEEN STUDIED, LA RANCE IS SO FAR THE ONLY TIDAL HYDRO-ELECTRIC INSTALLATION IN THE WORLD TO PRODUCE ELECTRICITY ON A COMMERCIAL SCALE.

DIAGRAM A SHOWS IN CLOSE-UP A CUTAWAY SECTION OF ONE OF THE 24 "BULB SETS" OF LA RANCE. EACH CONSISTS OF A BULBOUS METAL SHELL, SUPPORTED BY FIXED GUIDE VANES, IN A FIXED HORIZONTAL UNDERWATER TUNNEL. THE SHELL CONTAINS AN ALTERNATING-CURRENT GENERATOR LINKED TO THE SHAFT OF A FOUR-BLADE TURBINE WHICH IS AT THE SEAWARD END. A VERTICAL SHAFT ENABLES ENGINEERS TO CLIMB DOWN INSIDE THE SHELL FOR MAINTENANCE AND REPAIRS. THE TURBINE SPINS AT 94 REVOLUTIONS PER MINUTE AND OPERATES IN BOTH DIRECTIONS, THUS TAKING ADVANTAGE OF THE TIDAL FLOW BOTH WAYS.

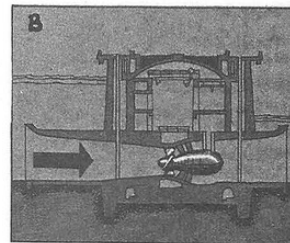
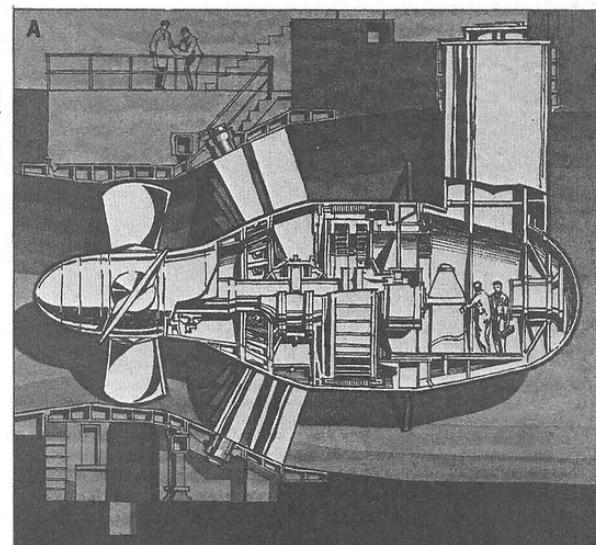
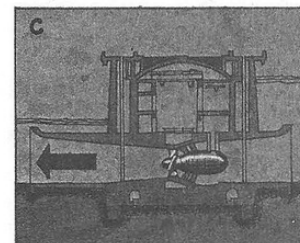
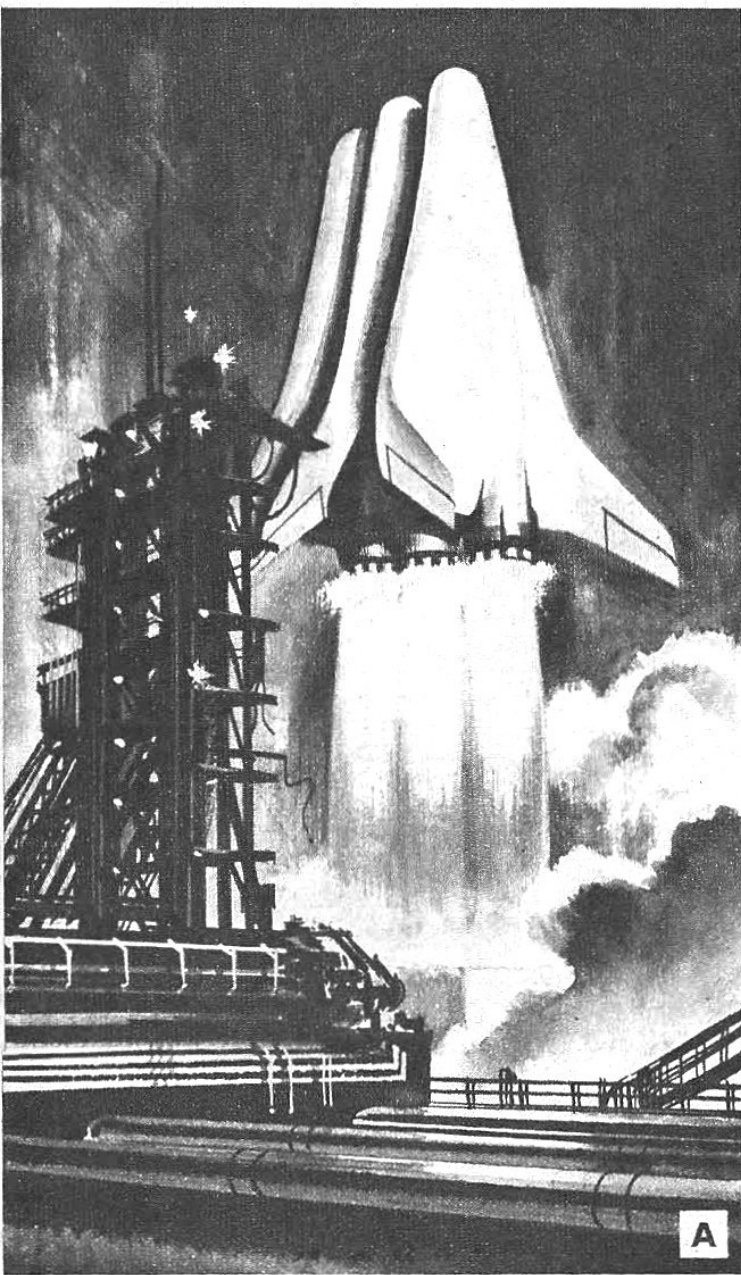


DIAGRAM B SHOWS THE POSITION OF THE TURBINE TUNNEL IN THE DAM, WITH THE CAVERNOUS STATION WORKING AREA ABOVE. THE INCOMING TIDE FORCES WATER INWARDS THROUGH THE TUNNEL AND SPINS THE TURBINE BLADES.



IN DIAGRAM C, THE WATER FLOW IS REVERSED AS THE TIDE RETREATS. PRESSURE ON THE RIVER BASIN SIDE FORCES THE WATER BACK PAST THE TURBINE AND SPINS IT IN THE OPPOSITE DIRECTION.

A NEW BRITISH SPACE VEHICLE



THREE years of work by research teams at the British Aircraft Corporation's aerospace department at Warton, near Preston in Lancashire, has produced an idea which is regarded as a breakthrough in future space travel.

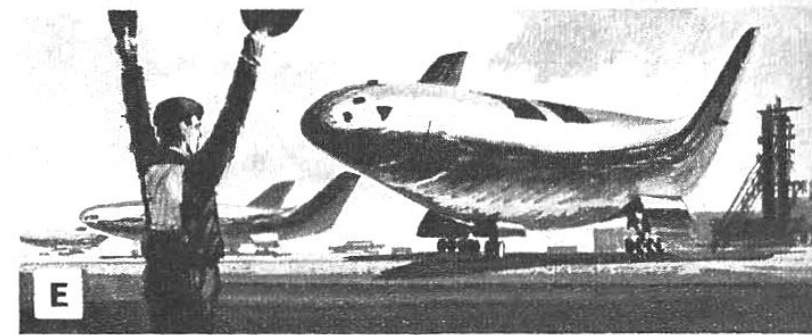
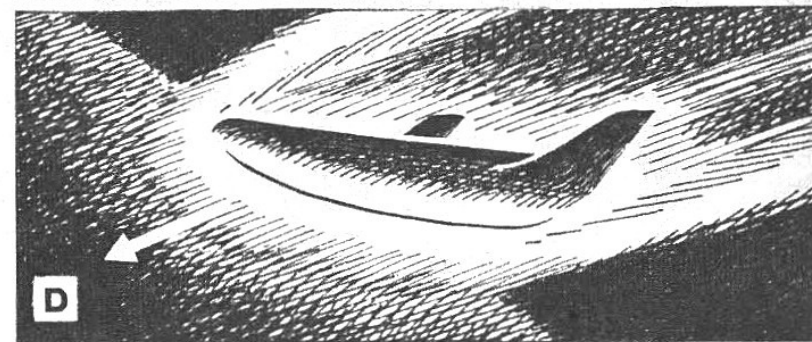
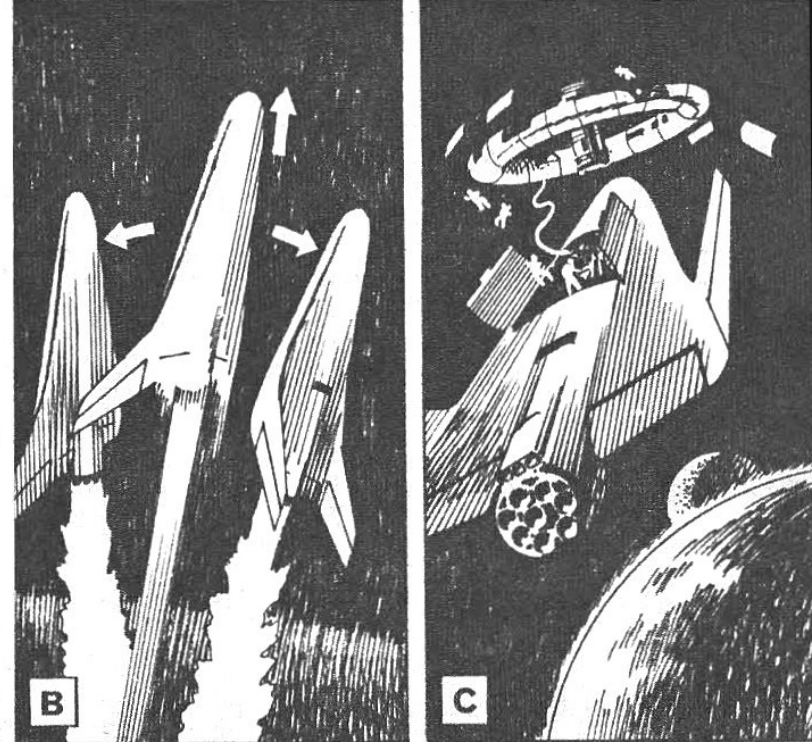
One of the disadvantages of the present satellite vehicles which the Americans have been putting into orbit is that the booster rockets used to hurl them into space became useless pieces of debris after fulfilling their purpose. If some way could be found of using the propulsion unit over and over again, the saving in time and money would be enormous.

Now, British scientists and technicians of B.A.C. have come up with an idea which has been code-named 'Mustard' (Multi-Unit Space Transport and Recovery Device), and it could become Europe's standard space vehicle in the 1980s.

It is made up of three identical manned units stacked together (see left). The two outer units boost the middle one to a speed of 4,530 m.p.h. and then break away and return to base. Using its own engine and fuel, the centre unit speeds on into orbit, carries out its task and then re-enters the atmosphere, making an aerodynamic landing near its launching site.

The propellants used by 'Mustard' would be liquid hydrogen and liquid oxygen. The three rocket motors are first fed with fuel from the tanks of the two outer units. These become exhausted at an altitude of about 150,000 feet, but small hydrogen-fuelled turbo-jet engines enable them to return and land at a speed of about 100 m.p.h.

Our artist's drawings show (A) a Mustard unit blasting off, all motors firing. (B) The outer units breaking away in the upper layers of the atmosphere. (C) Centre Unit going into orbit with its payload. (D) Unit re-entering the earth's atmosphere and (E) Landing on a normal aircraft runway.



**LOOKING
INTO
SCIENCE**

**HERE COMES
THE MOLE**

BREAKTHROUGH!

A RAIL tunnel built in 1885 and a road tunnel opened in 1934 burrow beneath the busy waters of the River Mersey at Liverpool. But the growing flow of traffic has made a third tunnel necessary. This is the MT2 through which traffic is expected to be flowing in the spring of 1971. The drilling is complete and the finishing work is now in hand.

A tunnelling machine, nicknamed "Big Mole" cut all but 500 ft. of this 7,360 ft. long MT2. "Big Mole" is a masterpiece of engineering. Not only does it grind its way through solid rock as easily as a mole burrows through earth, it also carries equipment behind it.

This allows a small gang of men to erect in position the big, curved concrete segments which form the tunnel's outer lining. As the "Big Mole" crawls forward, the concrete lining work keeps pace with it, the lining being only 16 ft. behind the cutter head all the time.

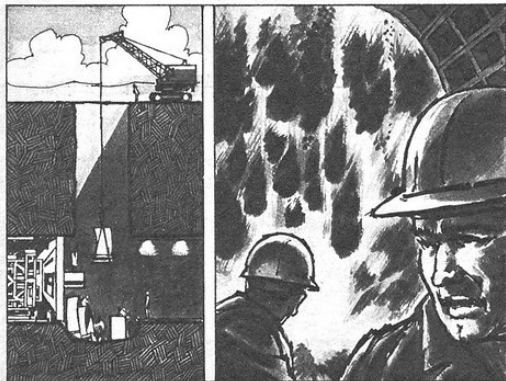
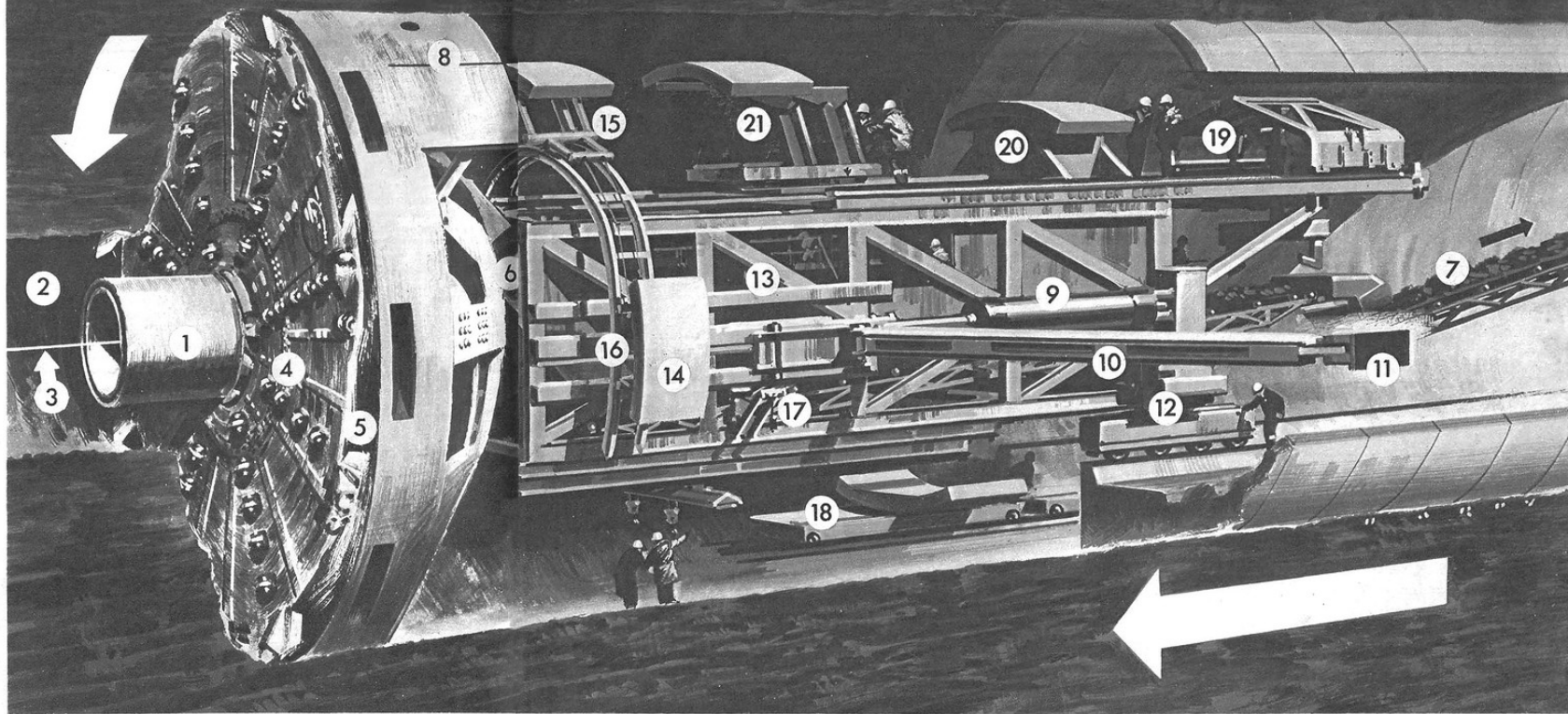
In the large illustration on the right of "Big Mole" at work, the tunnel lining has been cut away to show the details more clearly.

The Mole's hollow snout (1) projects into the previously cut pilot tunnel (2) down which is directed a laser beam (3) which keeps the machine cutting on the correct line.

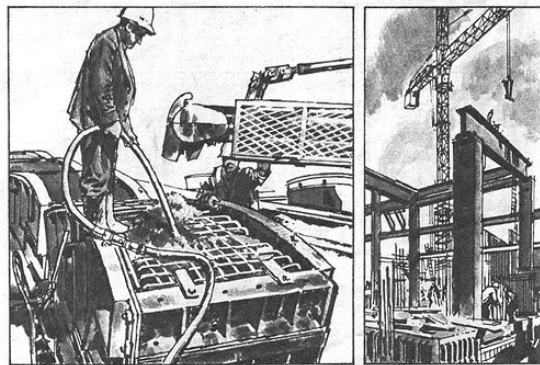
The cutting head (4) has a diameter of 33 ft. 11 inches and is studded with lines of circular tungsten-carbide blades which score into the rock and break it up. The broken rock is scooped up by big blades (5) mounted around the rim and fed down a chute (6) on to continuous belt conveyors (7) which carry it back down the tunnel for disposal. Behind the cutterhead is a protective roof shield (8).

To keep the cutting blades biting firmly into the rock face, a tremendous thrusting pressure is needed. This is provided by big, hydraulic cylinders (9) which exert pressure through hinged "propel arms" (10) on to thrust pads (11). The pads are set into a specially assembled grooved thrust channel on the tunnel wall.

The rear of the machine runs on wheeled bogies (12) which run in a grooved track laid ahead of the wheels. Steel girders (13) carry equipment for placing the lining segments (14) in place. The side and ceiling segments are positioned on erector cars (15) on a track (16). A boom crane (17) positions the lower side segments, and the bottom segments are carried on flat cars on rails (18). A power hoist (19) lifts the upper ceiling segments on to a rack (20) from where they are lifted by fork lift (21) on to the erector car (15) for final positioning. The Mole has a crew of about 18 to 20 men.

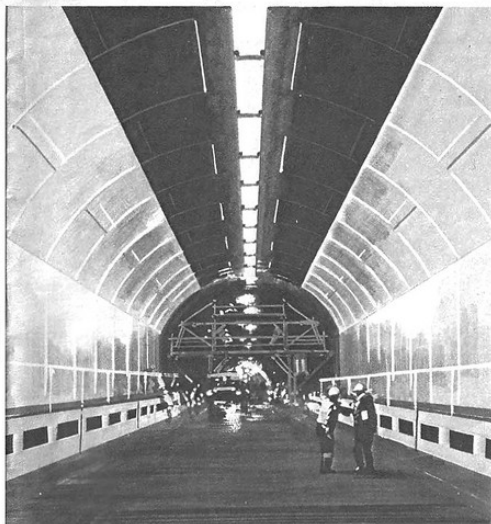


Once "Big Mole" had finished its job, it had to be removed from the tunnel it had cut. To enable this to be done, the engineers sank a special shaft at the point where the Mole's work would finish. Here, it was dismantled and hoisted out in sections by crane (above left). While they were sinking this shaft, a crew had a narrow escape. Without warning, about 400 tons of rock broke loose and crashed down. Luckily, seconds earlier, the men had left the area for their tea break. After it has been taken back across the Mersey and thoroughly overhauled, the Mole will be used again to cut a sister tunnel, to be called the MT2A. Incidentally, the Mole's record for a week of hard cutting was as much as 208 ft.



Thousands of concrete segments were needed for the outer lining of the tunnel, and these had to be supplied to keep pace with the Mole. Altogether, the tunnel labour force reached a peak of about 500 men, including many who worked in the block casting yards where the lining segments were mass produced. The concrete mixture was poured into special moulds and then mechanically vibrated (above left) to ensure strength and quality. While the tunnel was being cut and lined, work went forward on the shafts and buildings (above right) to house the massive ventilation equipment. The ventilation shafts are as wide as the tunnel itself. Provision has been made for the connection of the next tunnel—the MT2A—to the same clean air system. This uses giant fans to suck out vehicle exhaust fumes and to pump in clean air.

Prepared with the co-operation of Mott, Hay and Anderson, consulting civil engineers.



Before the tunnel will be open for traffic in the spring of 1971, a great deal of finishing work will have to be done.

One of the biggest tunnels ever cut by machine, the MT2 is the first underwater tunnel to use a new lining and finishing method. The concrete segments are moulded complete with bolting fixtures to the inner lining which consists of curved steel plates bolted together to form a ring when in position on the tunnel wall. These are then welded at the joints to provide a continuous, water-proof seal.

This smooth welded surface is ideal for protective and, finally, decorative painting.

The illustration on the left is an impression of part of the tunnel with the completed lining and painting. Strip lighting is installed over the reinforced concrete road deck which will form a two-lane vehicle highway. When the MT2A is finished, each tunnel will take full-width one-way traffic only.

A modern, well-lit, well ventilated road is useless unless the approach roads are suitable for the large flow of traffic using the tunnel.

On the right is an aerial view diagram of the approaches to the tunnel. These roads are major civil engineering projects in themselves, for they stretch back for miles on each side of the river.

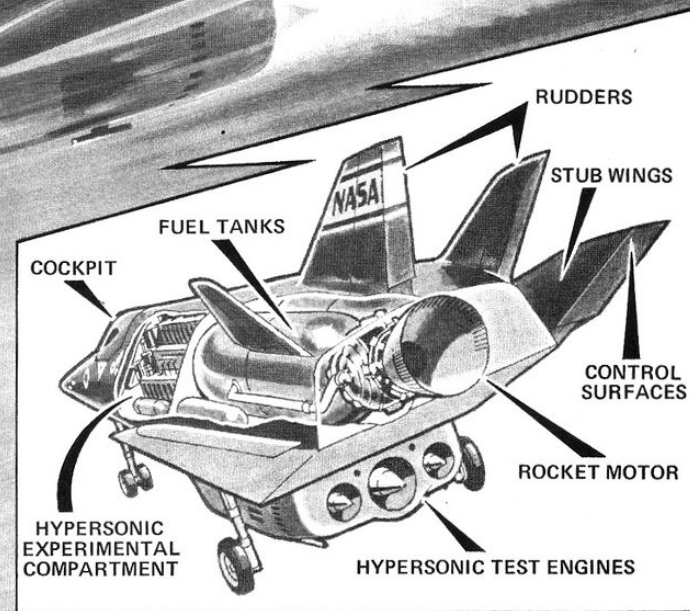
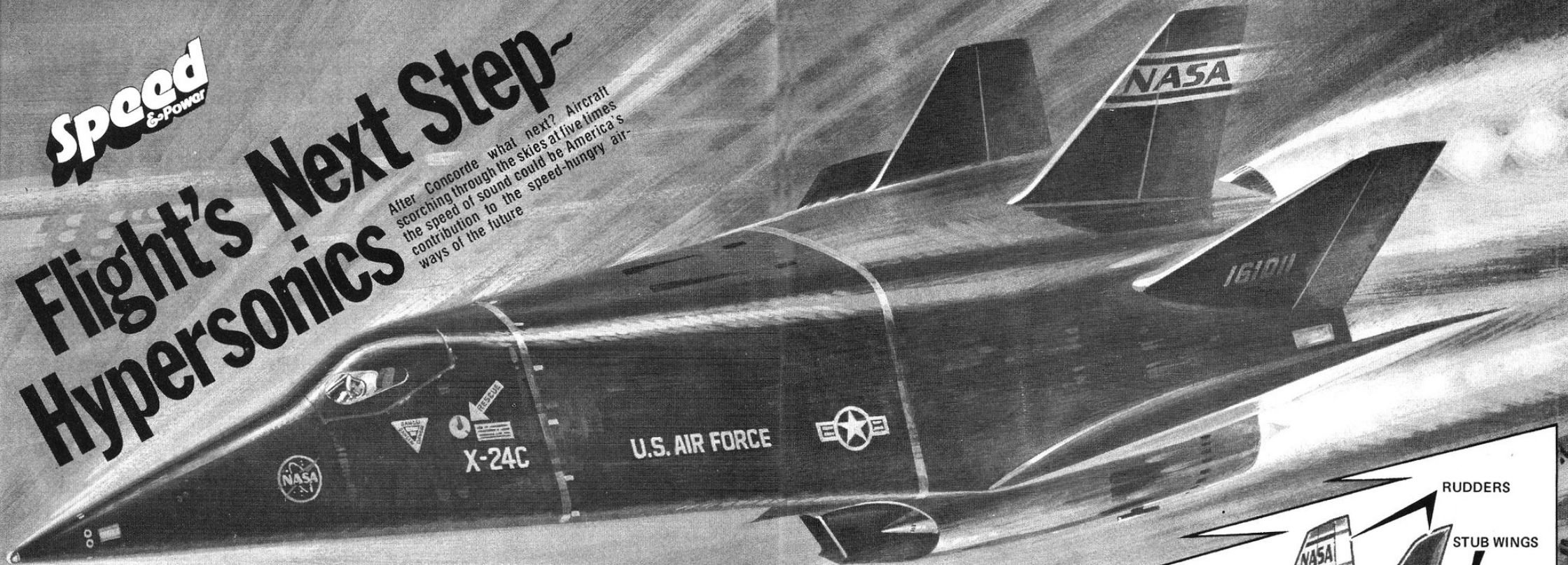
Because of these, there was no problem in disposing of the thousands of tons of rock cut from MT2, for it was all used in building the approach roads.



Speed & Power

Flight's Next Step~ Hypersonics

After Concorde what next? Aircraft scorching through the skies at five times the speed of sound could be America's contribution to the speed-hungry airways of the future



But the biggest problem of all is to counteract the effects of the terrific heat which is generated at hypersonic speeds. One answer would be to give the aircraft a skin made of a heat-resisting metal. Another way is to insulate the structure with a special material bonded to the aluminium — alloy frame. This material is charred by the heat, an action which insulates the main structure.

Both these methods can be flown experimentally on X-24C and the better one chosen for the first prototype.

With its blended wing fuselage 48.5 ft. (nearly 11 metres) long and its span of 24.2 ft. (just over 7 metres), it will be a stubby, power-packed speeding wizard — the forerunner of a whole new generation of airborne racers.

Expected to look like the craft in our illustrations above, the X-24C will be a flying test bed for equipment for a hypersonic plane of the future. Its details are shown in the cutaway (above). The information it would gather could help to produce an aircraft well over twice as fast as Concorde in the late 1990s (below).

TWICE the speed of sound is fast. That's chicken feed to the speed queen of the skies — Concorde. But set beside the latest dream plane of the Americans, Britain's get-you-there-fast Concorde will seem about as speedy as a crawling, furry caterpillar.

For the aerodynamics experts in the United States have set their sights on Mach 5 — five times the speed of sound. That is getting on for 4,000 miles an hour, or well over 64,000 kilometres an hour.

Hypersonics is what they call this, and it would lead to planes whisking us over the Atlantic from Britain to New York in less than an hour.

For some time, engineers in NASA — America's great space organisation — and the U.S. Air Force have been pooling their ideas to see how attractive hypersonic aircraft might be for commercial or military purposes.

Only one aeroplane has so far reached Mach 5. This is the North American X-15 which, between 1960 and 1968, made 199 flights. Of these, no fewer than 112 were at Mach 5 or above. On 3rd October, 1967, this impressive plane thrust the upper atmosphere aside at Mach 6.7 — or

4,520 mph (7,274 km/h) — a world record which seemed likely to stand for a long time.

With this achievement behind them, the Americans are not thought likely to try to compete with Concorde or the Russian Tu-144 by building a Mach 2 aircraft, but to leap-frog direct to Mach 4 or 5. They are thinking in terms of a basic design that could be built as an airliner carrying 300 passengers for journeys of several thousand miles on each trip, and an interceptor plane that would be valuable in wartime because of its ability to attack an enemy at a staggeringly fast speed.

Following detailed work on the theory of such a craft, NASA and the USAF decided to prove their theories by building a flying test bed — the X-24C shown in our big picture.

In order to keep the cost down, the plane's equipment will be adapted from that of existing aircraft wherever possible. It will weigh 55,437 lb. (about 25,000 kilograms) and will carry 39,300 lb. (about 17,000 kilograms) of propellant (71 per cent of its launch weight) in order to reach the speeds set for it.

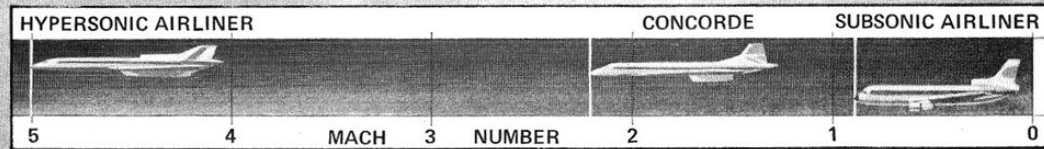
Its power plant will be a tried and proven rocket engine chosen from

units already used in launchers or previous research aircraft. The preferred engine is an uprated Thiokol XLR-99, almost identical with that used in the X-15 which holds the speed record. An improvement took the form of an extended nozzle and the ability to generate 61,000 lb. (about 27,000 kilograms) of thrust.

If the XLR-99 cannot be used for any reason, an alternative motor is one designed for the Atlas launch vehicle and designated LR-105. This provides 80,000 lb. (36,000 kg) of thrust. You may remember that this was used to launch the single-seat Mercury space craft.

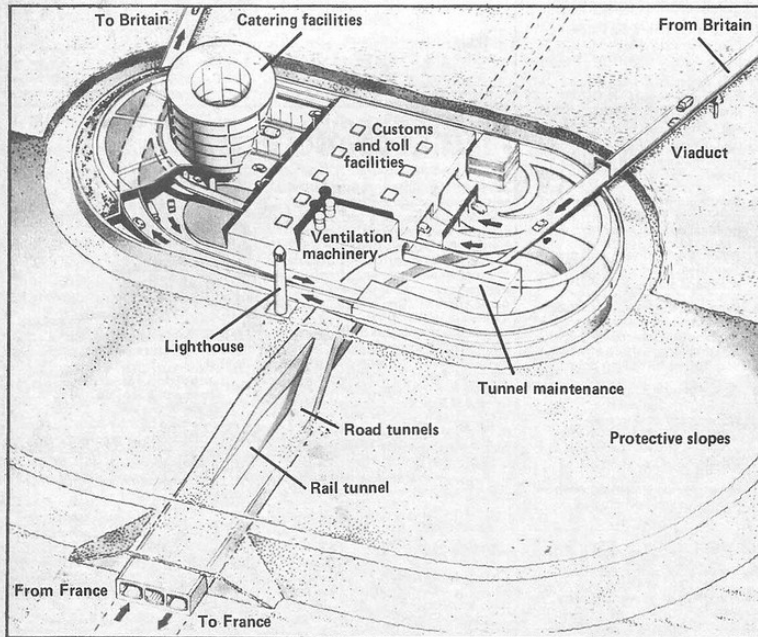
Three major tests are to be conducted with X-24C, all intended to discover the best kind of aircraft to travel at five times the speed of sound. These will determine its shape (what the designers call its configuration), propulsion (the best power plant and fuel), its structure and heat protection.

Into the category of propulsion there come a number of new air-breathing engine types, most of which have only been investigated in wind tunnels. Two of them are the turbo-ramjet and scramjet



A New Route To Europe?

The dream of a road and rail link between Britain and the Continent has inspired many ambitious schemes. The latest of these involves not only tunnels but man-made islands as well



British Offshore Island

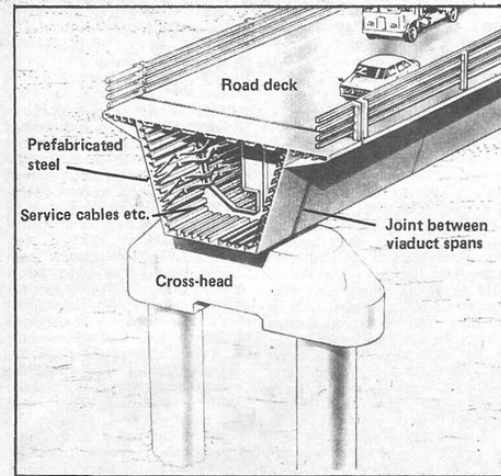
One of the most interesting proposals in the EuroRoute scheme is the construction of two artificial offshore islands. One of these will be situated about 8.5 kilometres out into the Channel from each coast, at the boundaries of the main shipping lanes. It is on these islands that the road traffic carried by the viaducts will transfer to the tunnel level. Based on the experience gained by British engineers in placing very large structures in the North Sea, the islands would be constructed by placing a large central concrete core on the sea-bed; this would then be surrounded by rock and other fillers to form protective slopes which would be heavily armoured.

EUROROUTE is the latest proposal for a combined road and rail fixed Channel crossing — a subject that has been discussed many times over many years. Produced by a British business consortium, the design has been developed after intensive research covering many considerations: financial, engineering, environmental and human.

The crossing would combine two 2-lane roadways and two rail tracks. While the railway is carried in an undersea tunnel throughout the crossing, the roadways would be carried on twin viaducts across the inshore Channel zones before merging into tunnels at specially-constructed offshore islands. The overall length of the crossing would be about 36km, with the central tunnel section approximately 19km long.

At a proposed cost of £3,800 million it is a massive undertaking. And the scheme would need careful study by the British and French governments.

But the backers are confident that, given the go-ahead, construction could begin in late 1983 and the first roadway could be opened to traffic in early 1989. We shall have to wait and see.



Viaduct section

The viaducts which carry the roadways over the inshore zones consist of a series of spans — each 125 metres long — which are supported by cross-heads connected to concrete piles which have been driven into the sea-bed. The spans will be constructed at various shipyards. It has been planned that the level of the viaducts will be well clear of the highest wave.

French coast

French offshore island

Ventilation islands

Ventilation Island

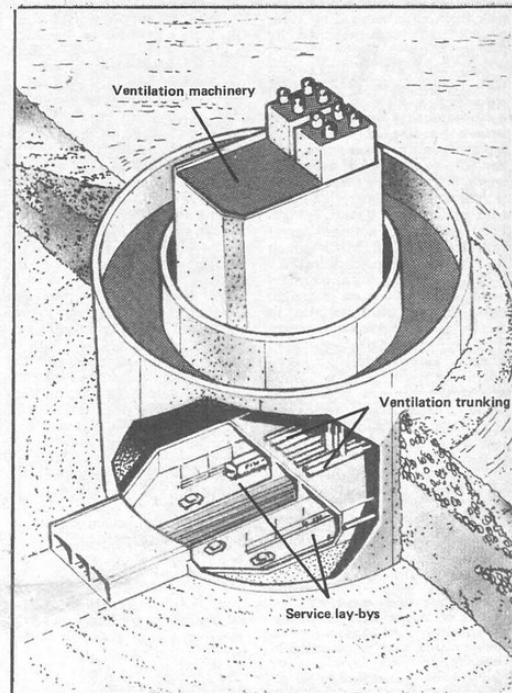
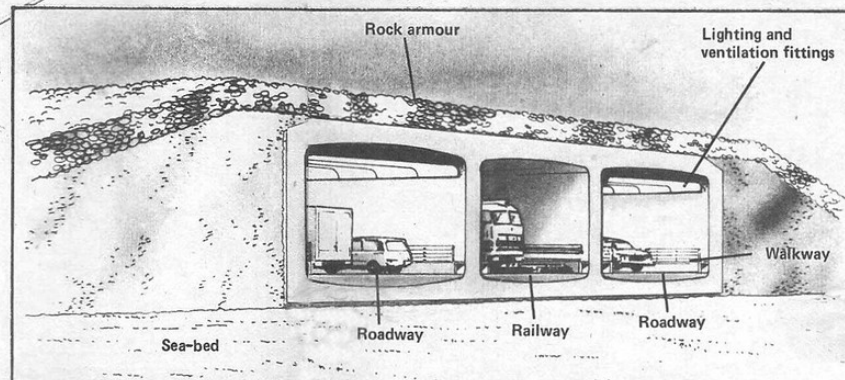
An important consideration in the tunnel proposals is the provision of an efficient ventilation system. This will be designed to cope effectively when the crossing is operating at full capacity, creating the worst conditions for exhaust fumes from cars and lorries. A main proposal is to use the central railway tunnel as a fresh air inlet duct. To allow this three intermediate ventilation islands will be built at selected points on the tunnel. These will be constructed in the same way as the main offshore islands, which will also house ventilation machinery. At these points fresh air will be introduced and exhaust air expelled from the tunnels. Additional ventilation services will be provided to deal with emergency conditions.

British offshore island

Road/rail tunnels

Tunnel section

Submerged tunnels will carry the rail-line across the inshore zones of the Channel link, and the combined rail and roadways across the central section. The tunnels will be constructed by joining 125-metre-long concrete elements which will be cast individually in special casting basins throughout Britain. Designed to be buoyant, the elements will be towed to the site of the tunnel by sea. Depending on local conditions the elements will then be sunk on to the seabed, or into a trench prepared below the sea-bed, and joined to form continuous tunnels. The central tunnel will carry the railway with the roadways in tunnels on either side. The tunnels will be heavily armoured and protected to minimise damage from any cause. This construction technique has already been used on several submerged tunnels throughout the world.



"CONSHELF THREE"



Captain Jacques-Yves Cousteau of France, has for many years been studying life beneath the seas. He has built a sphere called the "Consshelf Three" which can be lowered to the sea bed. Underwater divers, called oceanauts, can live in the sphere for long periods and take food and drink down with them. They study the fish and plant life around the Consshelf and can leave it, wearing diving suits, through a hatch. The sea water is kept out by the pressure inside the sphere. The men contact the headquarters on the surface by telephone and the people above can watch what is going on in the sphere by means of several television cameras, which are placed around the sphere. Medical experiments to see the effect of living under water are carried out on the divers in the sphere.

1. Commander talking to surface by telephone.

2. Test and Communications bench.
3. One of several T.V. cameras. All parts of sphere can be watched by H.Q. on surface.
4. Dining table.
5. Deep-freeze food store.
6. Spiral stairs to lower floor.
7. Diver preparing to leave by sea-hatch.
8. Bunk room. Laboratory also on lower floor.
9. Outside store for canned food.
10. Bag containing nine tons of water.
11. Legs supporting Consshelf on sea floor.
12. Ballast tanks. (On both sides).
13. Consshelf's emergency "lifeboat" for crew.
14. Power and communication cables to surface.
15. Capt. Cousteau's famous two-man "diving-saucer", illuminating an undersea oil well-head suspended from a supporting balloon.

ATOM RESEARCH FOR PEACE

Nearly everyone is now aware that man can split the atom. Few of us know how this is done, but we are all interested in results.

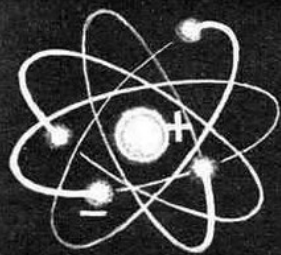
A longer, healthier, more abundant lifespan for all mankind draws closer as we learn how to use nuclear energy for peace and useful works.

We show here, in simplified form, some facts about

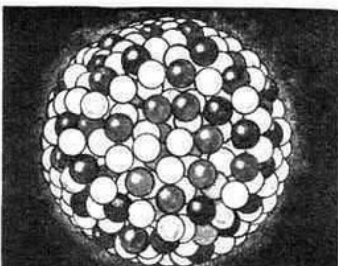
the atom, and describe a training nuclear research reactor. This type is used as a source of neutrons for research work; for training of personnel in the operation of atomic installations; for testing materials in reactor working conditions, and for producing radioactive isotopes ('radio-isotopes'), of importance to industry, agriculture and medicine.



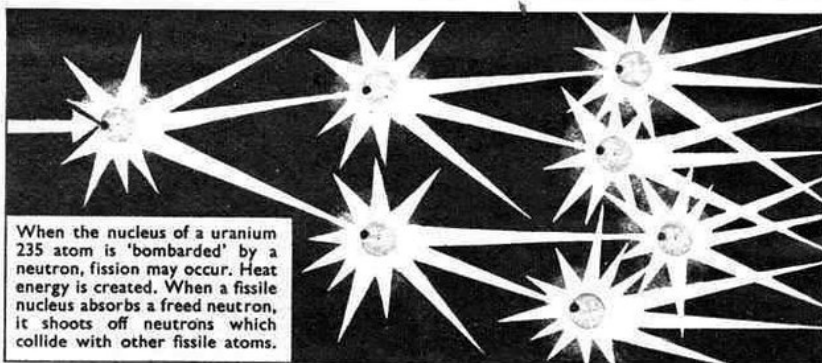
All 'substances' are built of atoms. A substance of chemically identical atoms is an element: hydrogen and iron are elements. Different atoms linked together form specific materials; e.g. two atoms of hydrogen and one oxygen constitute water.



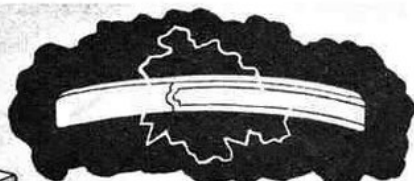
Atoms are like solar systems. At centre is the nucleus (sun) with a positive electrical charge. Around it rotate electrons (planets) with a negative charge.



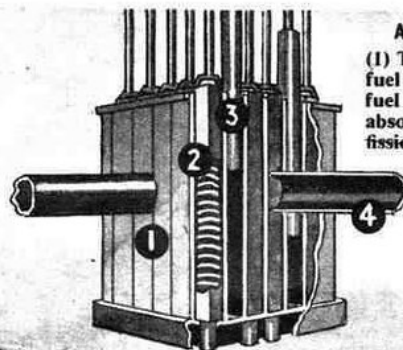
A nucleus of uranium is a relatively heavy cluster of closely packed elementary particles: protons (92) and neutrons (146). Neutrons have no electrical charge.



When the nucleus of a uranium 235 atom is 'bombed' by a neutron, fission may occur. Heat energy is created. When a fissile nucleus absorbs a freed neutron, it shoots off neutrons which collide with other fissile atoms.

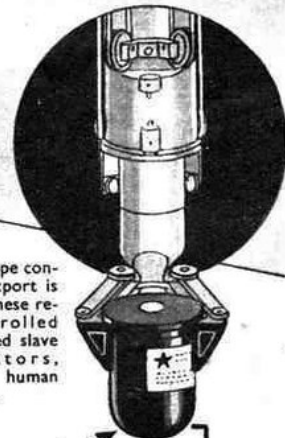


A rod of natural uranium is composed of a mixture of fissile atoms (U.235), and fertile atoms (U.238). Proportion 1-140. Uranium fuel is canned in aluminium, and contained in water, which acts as a 'moderator' and slows the velocity of liberated neutrons. This facilitates fission. Right is a fuel container for an atomic reactor core. Water passes up centre.



A RESEARCH REACTOR CORE

(1) The core, containing 20 or more fuel elements. (2) Enriched uranium fuel element. (3) Control rod which absorbs neutrons and maintains the fission process in balance. (4) Beam tube in which material is subjected to radiation for testing.



A radio-isotope container for export is handled by these remote controlled 'fingers' called slave manipulators, resembling human wrist action.

RADIO-ISOTOPES FOR THE BENEFIT OF MANKIND

In the service of medicine, studying body functions and destroying cancer, etc.

Fertilizer, crop growth and plant function research.

Preservation and sterilization of foodstuffs without refrigeration.

Study of animal diet, improving the meat and milk yield.

POOL-TYPE NUCLEAR RESEARCH REACTOR

This research reactor, made by American Machine & Foundry Co., New York, for atomic training centres, is an open pool of ordinary (light) water into which the reactor core is suspended from a movable bridge. (1) Reactor core. (2) Fuel elements of enriched uranium. (3) Control rods. (4) Beam tube, in which samples are subjected to radiation. (5) Most elements can be made radio-active by 'bombarding' them with streams of particles, emitted in a nuclear reactor. (6) 'Burnt-up' reactor fuel. (7) Graphite

thermal column slowing down freed neutrons for experiments. (8) Concrete shielding. (9) Beam tube on other side. (10) Suspended reactor frame. (11) Movable bridge. (12) Control rod mechanism. (13) Control room. (14) The bridge can be moved forward to any position. (15) The pool is 25 ft. deep. The water acts as a reactor coolant, moderator and shield. (16) Gate to second pool, which can be drained to allow positioning of experimental apparatus. It is then filled, the gate opened and the movable reactor passed through.

ASHWELL WOOD

Radio-active products for turning household refuse into fertilizers.



Post Office Tower

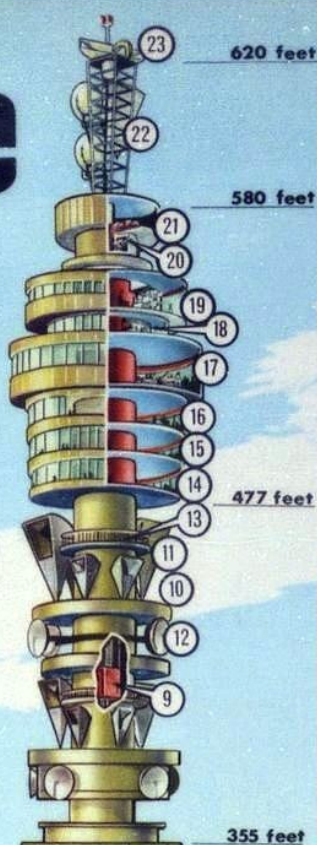
Rising stark above London's skyline is a new and impressive landmark, the Post Office Tower. The new Tower will be the tallest building in Britain. Situated near Tottenham Court Road, the Tower is no 'head-in-the-clouds' venture for it plays an important part in London's communications system.

Telephone conversations, besides being carried by wire are nowadays transmitted by micro-wave radio beams, each beam being capable of carrying over a thousand individual telephone calls at once. These beams are rather like searchlight beams, and are transmitted from aerials which are situated high enough to give the beams an obstacle-free path. Hence the reason for the Post Office Tower—to carry aerials high enough to transmit and receive beams far above the roof-top level of the highest of London's buildings.

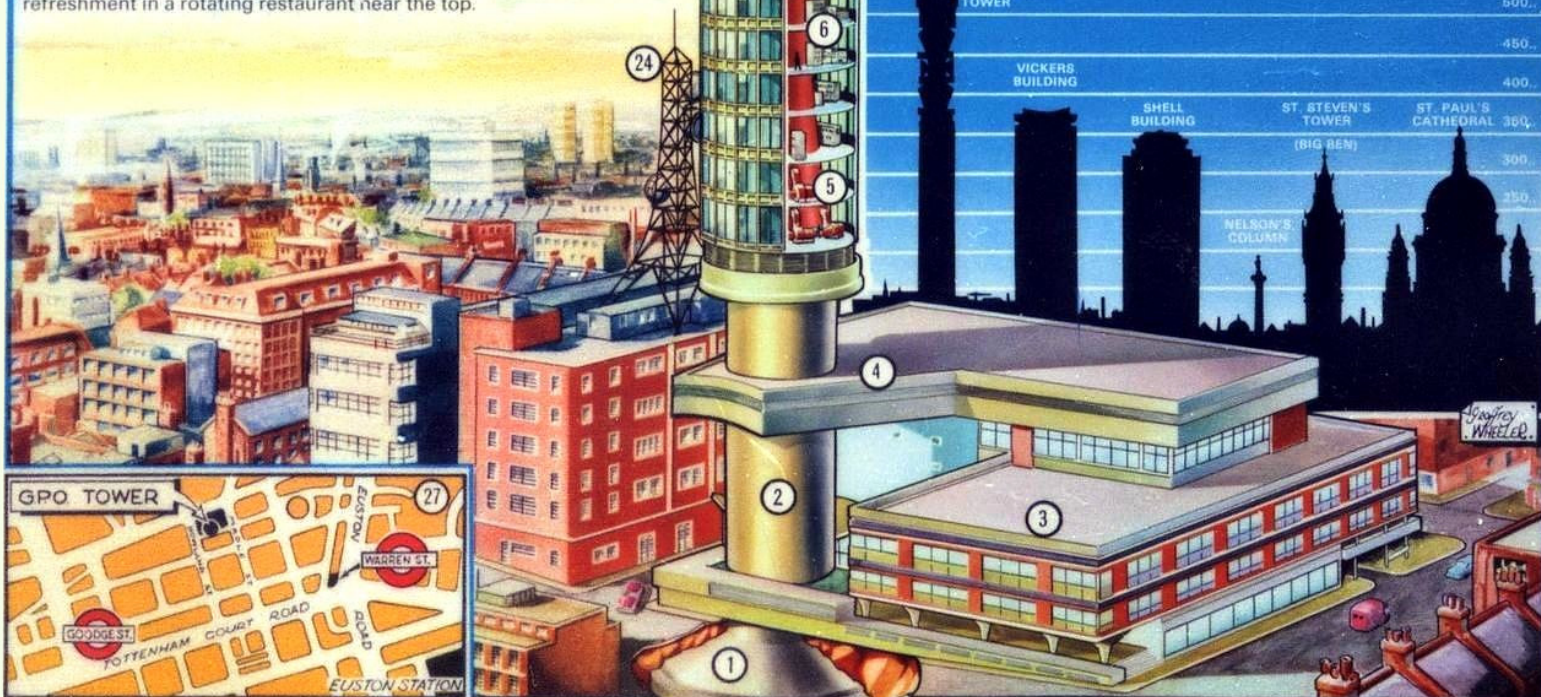
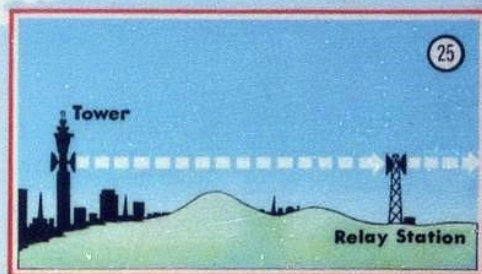
From the Tower will radiate telephone calls to quarters as far afield as Manchester, Norwich, Bristol and Southampton—but not direct, however, as the beams are limited to a range of some 30 miles and must be relayed to their destination in a series of hops by relay stations which receive and re-transmit the beams. Provision is also made for television programmes to be relayed.

The Tower is 620 feet high, and weighs 13,000 tons. It is constructed of concrete reinforced with high tensile and mild steel and has no less than 50,000 square feet of glass on its outside covering. It will withstand high winds with the minimum of deflection—so as not to upset the alignment of the radio beams. Gusts of 90 mph are estimated to induce a deflection of 15 inches at the top of the Tower!

The Tower will be open to visitors, to provide a vast panoramic viewpoint overlooking the whole of London, and will also offer refreshment in a rotating restaurant near the top.



This illustration originally appeared in the boys' paper 'Eagle' issued 23rd May 1964 and we are grateful to the publishers, The Longacre Press Ltd., for granting permission to the Post Office to reproduce it.



KEY TO NUMBERED PARTS

- | | | | |
|--|--|---|---|
| (1) Pre-stressed concrete foundations. | telephone and television equipment. These extend for 13 further floors. | (11) Horn aerials. | (21) Room containing high-speed lift motors, water tanks and further ventilating equipment. |
| (2) Reinforced concrete shaft. This extends the full height of the Tower and forms the backbone around which the Tower is built, and contains the lift shaft, ventilating ducts and cables for radio equipment, etc. | (7) Double glazing with automatic Venetian blinds sandwiched between glass. | (12) Dish aerials. | (22) 40-foot steel mast carrying further aerials. |
| (3) The new MUSEum Telephone Exchange. | (8) Rails extending the full height of the glazed portion to accommodate special power-operated cradles for window cleaning. | (13) Aerial inspection platforms. | (23) Storm warning radar scanner. |
| (4) Connecting bridge from Exchange building to Tower, which also serves to brace the Tower. | (9) Two high-speed lifts capable of travelling at 1,000 feet per minute—the fastest lifts in Britain. | (14), (15) and (16) Public observation platforms. | (24) Existing 180-foot lattice mast and aerials. |
| (5) High velocity ventilating equipment rooms. | (10) Aerial gallery. | (17) The unique revolving restaurant with an all-round view of London, completing one revolution in approximately half-an-hour. | (25) Inset diagram showing how the aerials on the Tower transmit micro-wave beams. |
| (6) Transmitting apparatus rooms containing | | (18) Cocktail bar. | (26) Skyline comparison of the Post Office Tower with some of London's tallest buildings. |
| | | (19) Kitchen. | (27) Location map for the visitor to the Tower, showing nearest underground stations. |
| | | (20) Lift pulley compartments. | |

VICKERS VA-3 HOVERCRAFT

In 1962, British United Airways, using the Vickers VA-3, started the first commercial hovercraft service in the world. Operating between Wallasey and Rhyl, a distance of 19 miles, the VA-3 can complete the journey with full payload of 24 passengers in less than half an hour at a speed of some 60 knots. All hovercraft operate on the same principle - i.e., creating a cushion of air between the underside and the ground; this, with some form of forward propulsion, enables them to travel over any flat surface, either land or water.

The VA-3 has four engines. Two of these operate the forward and rear lift fans; the remaining two are for forward propulsion. The lift fans create the air cushion on which the VA-3 rides. Red arrows indicate the airflow.

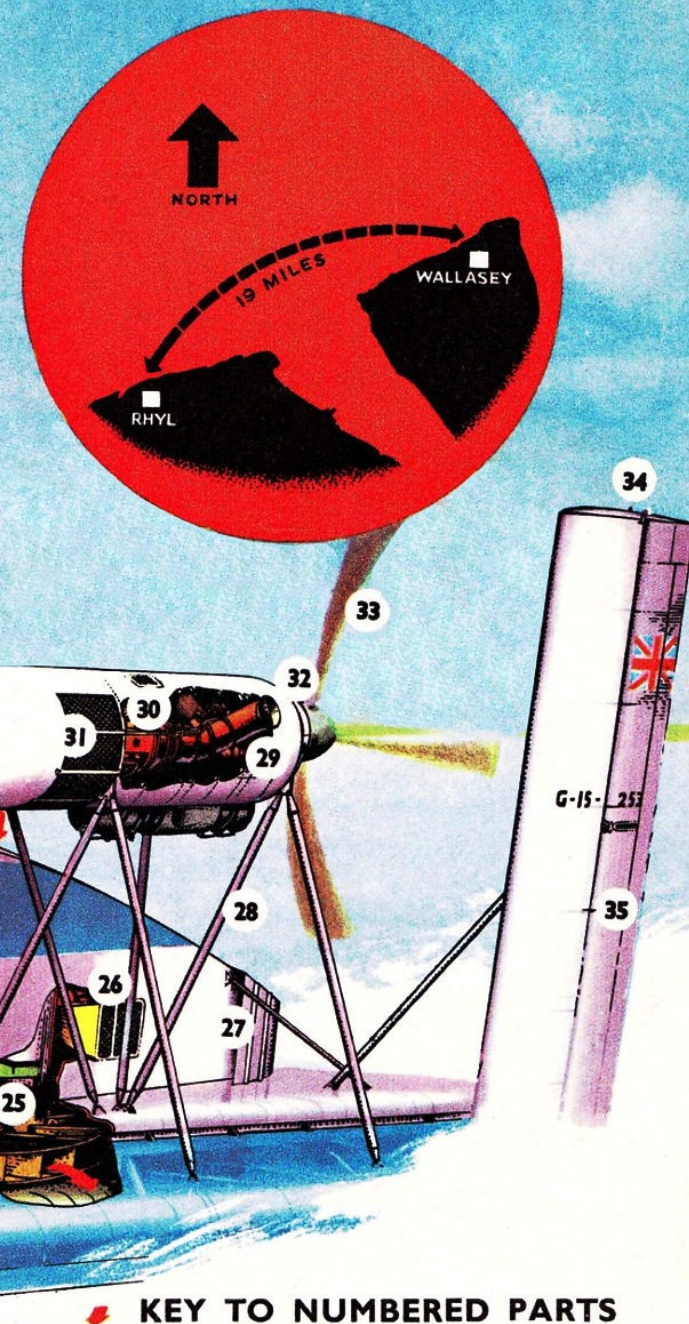
Control of the hovercraft is achieved by propeller pitch, and the forward and rear rudders. The forward rudders are, in fact, free floating, and are controlled by trim tabs. The fuel tank, which has a capacity of 375 gallons, is located under the

main cabin, forward of the rear lift fan. In the main, the machine is made up of bulkheads connected by longerons, the whole structure being covered by thin-gauge metal. The main cabin has a flexible joint in the centre to reduce strain in heavy seas. Propulsion engines are mounted on round section metal struts.

Basic details:-

Powerplant: Four Bristol Siddeley Turmo 603 free turbine engines of 425 shaft horse-power.

Overall length: 54 ft. 9 ins.; width, 26 ft. 11 ins.; height, 17 ft. 9 ins.; cushion area, 895 sq. ft.; cushion pressure at maximum loaded weight, 31.716 lb. per sq. ft.; cruising speed, 60 knots; rise height, 8 ins.; still air range, 92 nautical miles.

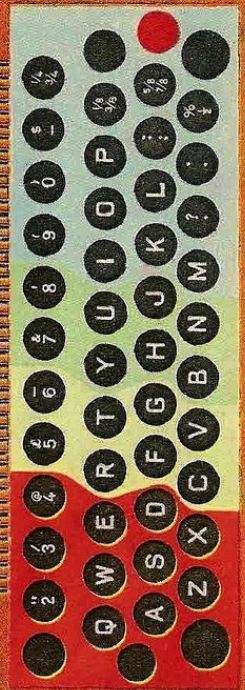
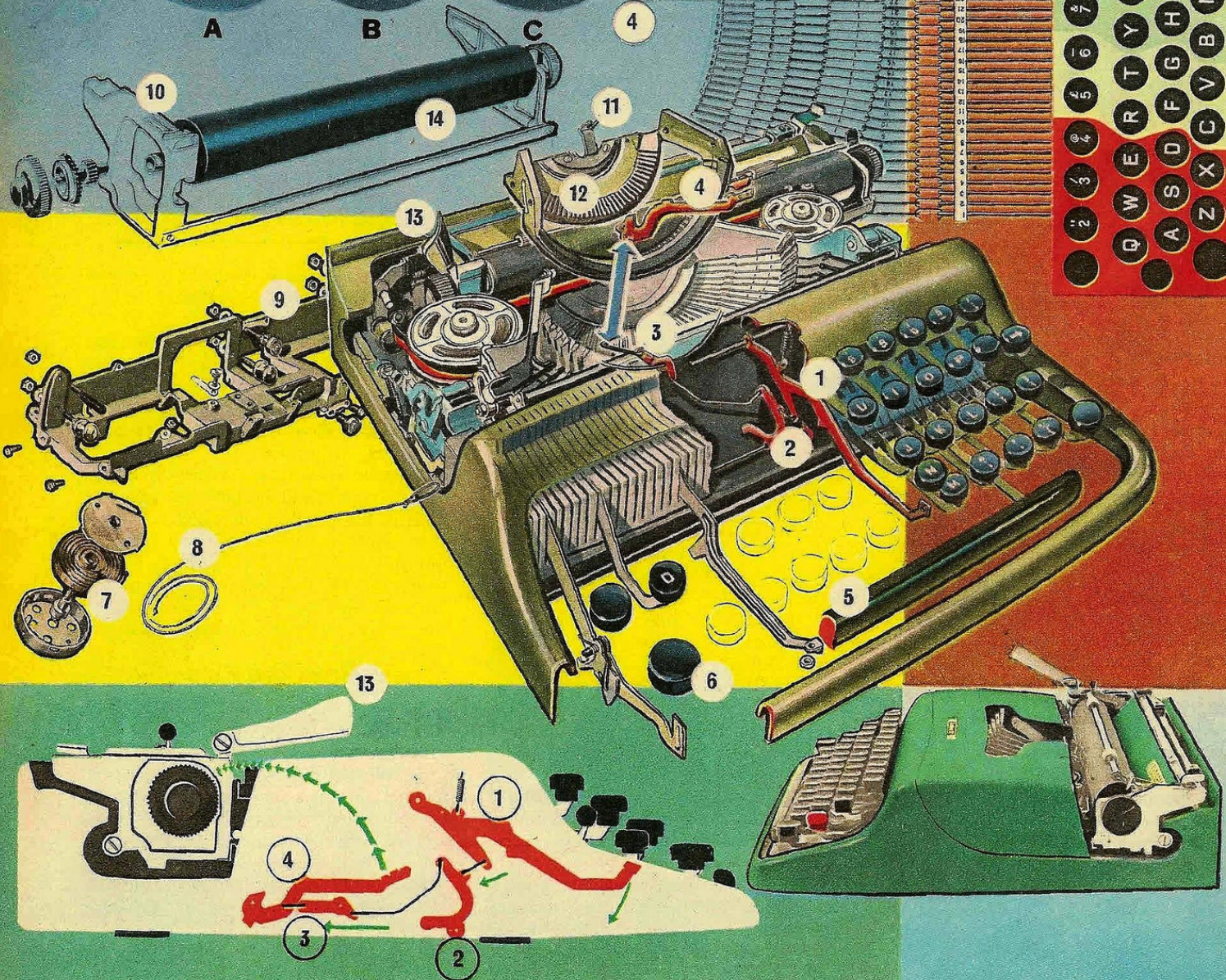
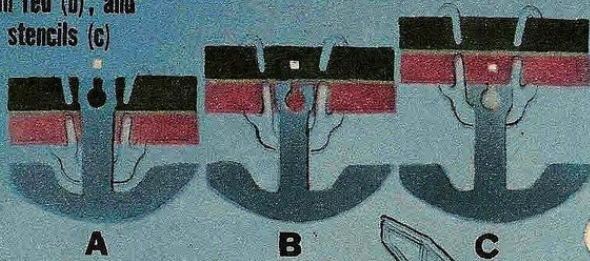


KEY TO NUMBERED PARTS

(1) Towing and mooring points. (2) Forward starboard fin. (3) Bristol Siddeley Free turbine engine. (4) Removable bow section. (5) Engine oil cooler. (6) Turbine exhaust and noise suppressor. (7) Driver's position. (8) High-speed screen wipers. (9) Aerial. (10) Starboard propulsion engine. (11) Starboard rear rudder and fin. (12) Cabin air-ducts. (13) Forward lift fan duct. (14) Driver's and navigator's cabin. (15) Structural support for fan bearing. (16) Forward lift fan. (17) Main buoyancy tanks. (18) Spray deflector. (19) Non-slip walkway. (20) Rearward-facing seats. (21) Cabin door. (22) Main cabin seating 24 passengers. (23) Forward port fin. (24) Flexible cabin joint. (25) Rear lift fan. (26) Engine exhaust. (27) Air intake duct to engine. (28) Engine mounting struts. (29) Drive shaft to reduction gearbox. (30) Port propulsion engine. (31) Engine intake. (32) Engine exhaust. (33) Dowty-Rotol variable pitch propellers. (34) Port fin. (35) Port rudder.

KEYS TO MANY WORDS

Position of ribbon carrier for: typing in black (a); in red (b); and for cutting stencils (c)



WHEN you write by hand, the paper keeps still while the point of your pen moves across it from left to right. But when you write on a typewriter, the point (11) on which each typebar (4) converges remains still, while the paper, mounted on a carriage (10) running on roller bearings (9), passes across it from right to left.

You begin typing by winding the paper round the carriage platen (14) and pushing the carriage to the extreme right so that the writing point is in line with the left-hand margin on the paper. The main spring (7) fixed to the typewriter frame is now tightly wound, because the nylon cord (8) connecting one end of it to the right-hand end of the carriage is fully extended; a lock underneath stops the spring pulling the carriage towards the left.

When you depress a typing key you set the four interlinked levers (1), (2), (3), and (4) (the typebar) in motion. As they begin to move, the "tail" on lever (2) operates the ribbon mechanism and causes a fresh strip of ribbon to come between the paper and the rising typebar.

Space Bar

AS you depress the key further, the typebar gathers speed until the bottom one of the two characters engraved on it strikes the ribbon against the paper and prints the character. Immediately, the butt end of the typebar releases the carriage lock and allows the main spring to pull the carriage one place to the left, ready for the next character to be printed. As you release the key, the small spring which

connects the lever (1) to the typewriter frame pulls all four levers back to their original position.

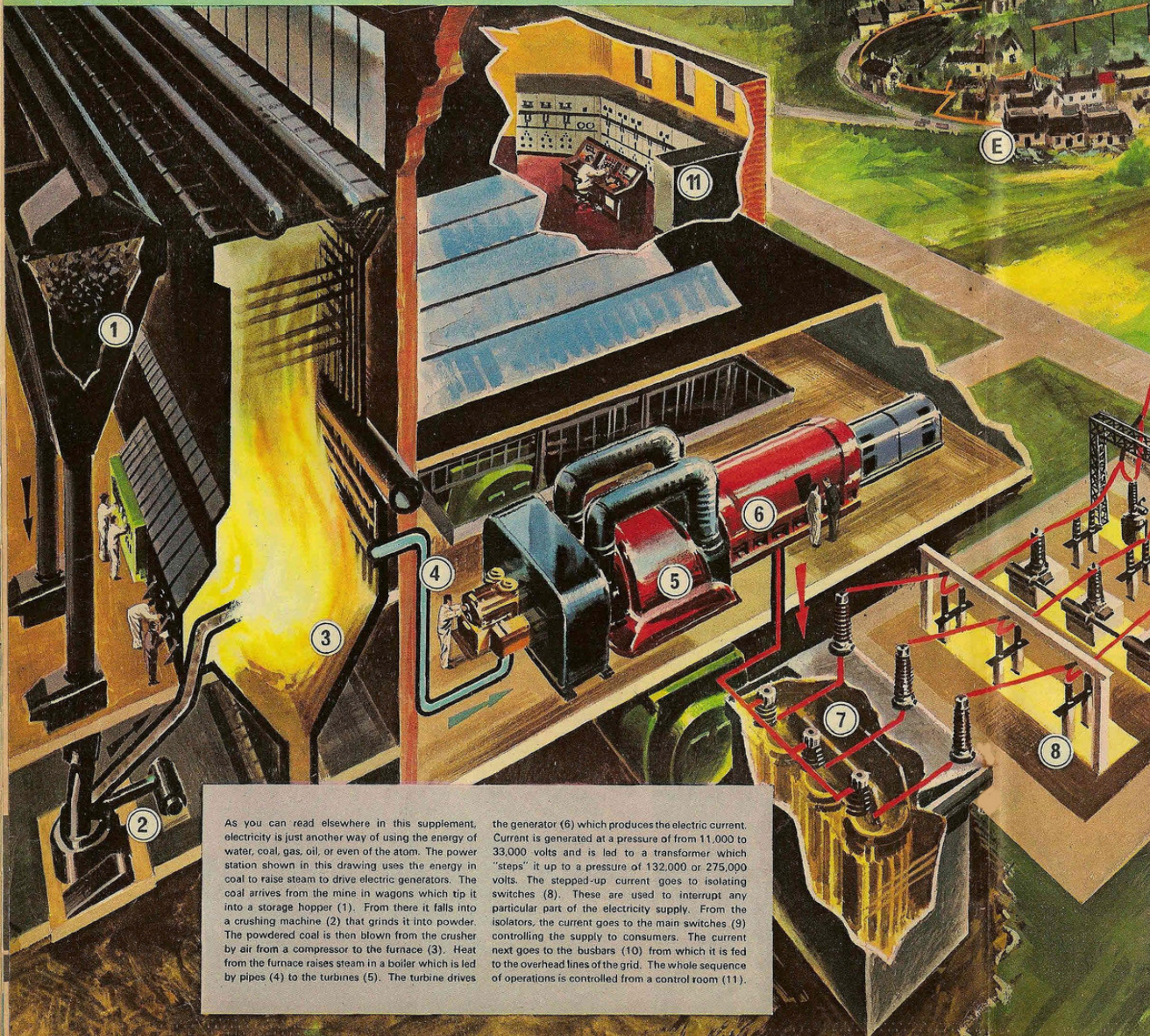
For spaces between words you depress the space bar (5), which releases the carriage lock without printing a character. To type a capital instead of a small letter, you first depress the shift key (6): this lowers the typebar segment (12) so that the typebar pivots from a lower position and strikes with the top (capital) letter instead of the bottom (small) letter.

At the end of each line the carriage has been pulled to the left, and the main spring is more or less unwound. By pushing the lever (12) towards the right you revolve the paper on the platen up to the next line, and at the same time return the carriage to the right. This again extends the nylon cord, and so rewinds the main spring.

LOOK AND LEARN FOCUS ON

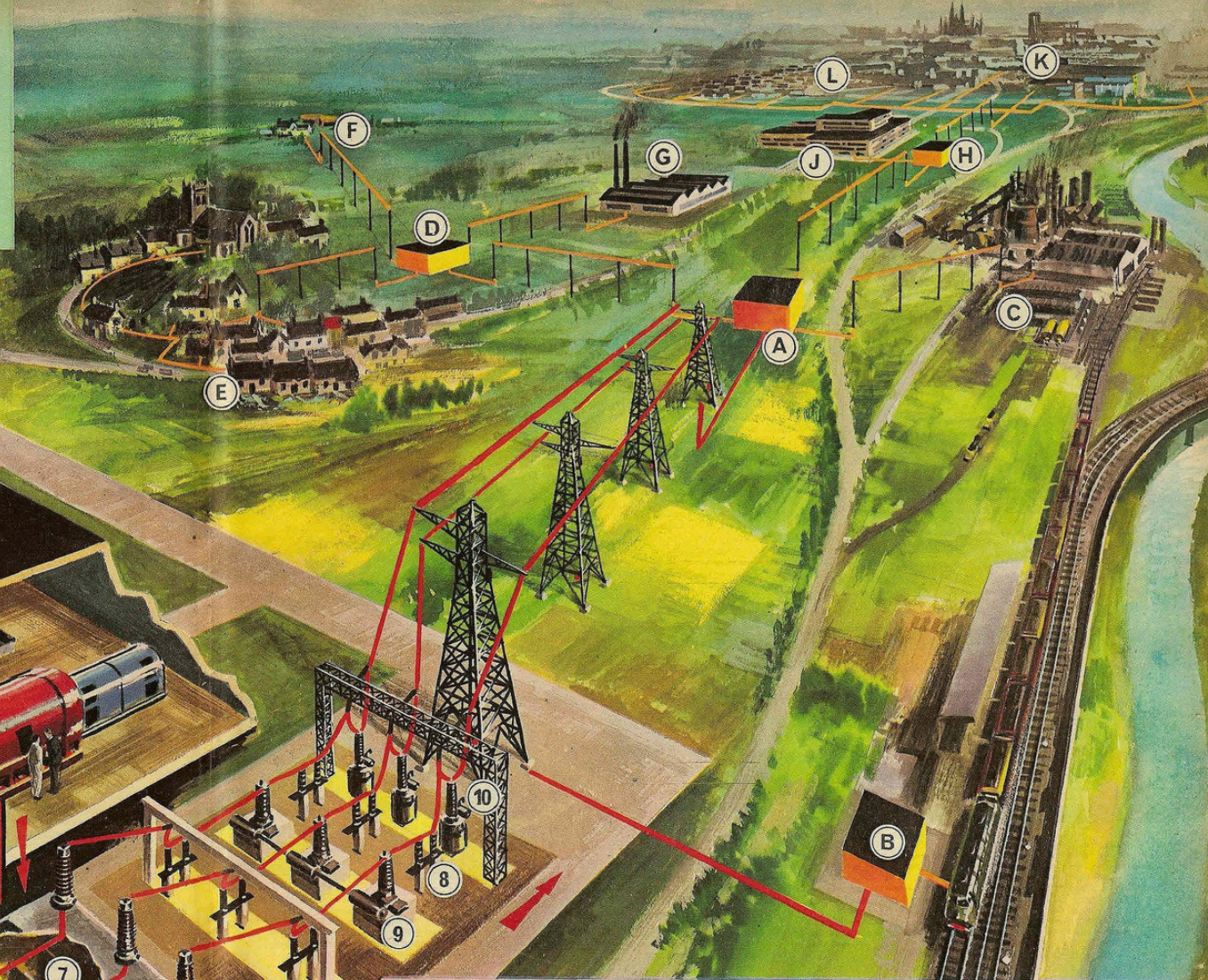
ELECTRICITY

The Power You Never See



As you can read elsewhere in this supplement, electricity is just another way of using the energy of water, coal, gas, oil, or even of the atom. The power station shown in this drawing uses the energy in coal to raise steam to drive electric generators. The coal arrives from the mine in wagons which tip it into a storage hopper (1). From there it falls into a crushing machine (2) that grinds it into powder. The powdered coal is then blown from the crusher by air from a compressor to the furnace (3). Heat from the furnace raises steam in a boiler which is led by pipes (4) to the turbines (5). The turbine drives

the generator (6) which produces the electric current. Current is generated at a pressure of from 11,000 to 33,000 volts and is led to a transformer which "steps" it up to a pressure of 132,000 or 275,000 volts. The stepped-up current goes to isolating switches (8). These are used to interrupt any particular part of the electricity supply. From the isolating switches, the current goes to the main switches (9) controlling the supply to consumers. The current next goes to the busbars (10) from which it is fed to the overhead lines of the grid. The whole sequence of operations is controlled from a control room (11).



At suitable points on the grid network there are primary sub-stations (A) where the grid voltage, in this case 132,000 volts, is stepped down by transformers to suit requirements in the area served by the sub-station. There are also secondary transformer stations (D) which step the current to the still lower voltages to suit local needs. There are also special transformer stations for changing the current for domestic uses in towns (H), and cities (K). From these sub-stations the current is led to housing estates (L), hospitals (J), factories engaged in light industry (G) and heavy industry (C). Other sub-stations serve current to isolated farms (F) and villages (E). There are also sub-stations which transform current from the grid to the correct voltage needed by electric railways (B). In the year ending March 1963, the power stations in Britain generated nearly two hundred million units of electric current. The Central Electricity

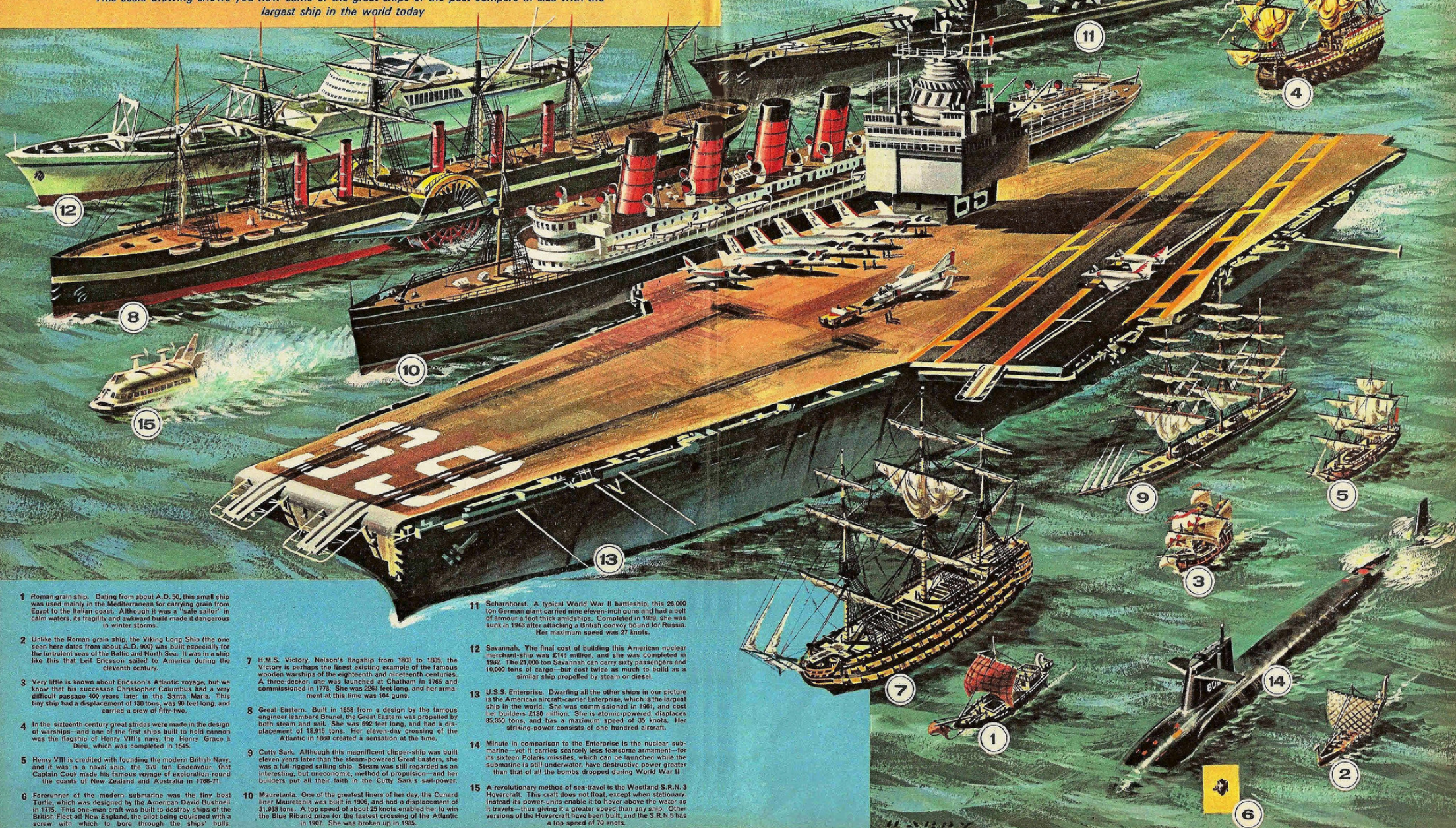
Generating Board is responsible for the generation and transmission of electric current throughout England and Wales and operates the largest power system in the world. The whole of the electricity system is connected together by over 8,190 miles of high-voltage transmission lines—most of them supported on steel pylons. About three-quarters of the total length of lines and cables operate at 132,000 volts and 1,852 miles at 275,000 volts. Every year the Central Electricity Generating Board uses over 57 million tons of coal in its power stations, besides nearly 900,000 tons of coke and 5½ million tons of fuel oil. The Board owns a fleet of 29 ships to carry coal from the collieries to the power stations. Other power stations receive their coal by railway, and at some twelve trainloads arrive every day. The coal is handled at the rate of 1,000 tons a day. There are also two stations which use nuclear power.

LOOK AND LEARN FOCUS ON...

BIG SHIPS AND LITTLE SHIPS

Through The Ages

This scale drawing shows you how some of the great ships of the past compare in size with the largest ship in the world today



1 Roman grain ship. Dating from about A.D. 50, this small ship was used mainly in the Mediterranean for carrying grain from Egypt to the Italian coast. Although it was a "safe sailor" in calm waters, its fragility and awkward build made it dangerous in winter storms.

2 Unlike the Roman grain ship, the Viking Long Ship (the one seen here dates from about A.D. 900) was built especially for the turbulent seas of the Baltic and North Sea. It was in a ship like this that Leif Ericsson sailed to America during the eleventh century.

3 Very little is known about Ericsson's Atlantic voyage, but we know that his successor Christopher Columbus had a very difficult passage 400 years later in the Santa Maria. This tiny ship had a displacement of 100 tons, was 90 feet long, and carried a crew of fifty-two.

4 In the sixteenth century great strides were made in the design of warships—and one of the first ships built to hold cannon was the flagship of Henry VIII's navy, the Henry Grace à Dieu, which was completed in 1545.

5 Henry VIII is credited with founding the modern British Navy, and it was in a naval ship, the 370-ton Endeavour (that Captain Cook made his famous voyage of exploration round the coasts of New Zealand and Australia in 1768-71).

6 Forerunner of the modern submarine was the tiny boat Turtle, which was designed by the American David Bushnell in 1775. This one-man craft was built to destroy ships of the British Fleet off New England, the pilot being equipped with a screw with which to bore through the ships' hulls.

7 H.M.S. Victory, Nelson's flagship from 1803 to 1805, the Victory is perhaps the finest existing example of the famous wooden warships of the eighteenth and nineteenth centuries. A three-decker, she was launched at Chatham in 1765 and commissioned in 1778. She was 228 feet long, and her armament at this time was 104 guns.

8 Great Eastern. Built in 1858 from a design by the famous engineer Isambard Brunel, the Great Eastern was propelled by both steam and sail. She was 692 feet long, and had a displacement of 18,915 tons. Her eleven-day crossing of the Atlantic in 1869 created a sensation at the time.

9 Cutty Sark. Although this magnificent clipper-ship was built eleven years later than the steam-powered Great Eastern, she was a full-rigged sailing ship. Steam was still regarded as an interesting, but uneconomic, method of propulsion—and her builders put all their faith in the Cutty Sark's sail-power.

10 Mauretania. One of the greatest liners of her day, the Cunard liner Mauretania was built in 1906, and had a displacement of 31,938 tons. A top speed of about 25 knots enabled her to win the Blue Riband prize for the fastest crossing of the Atlantic in 1907. She was broken up in 1935.

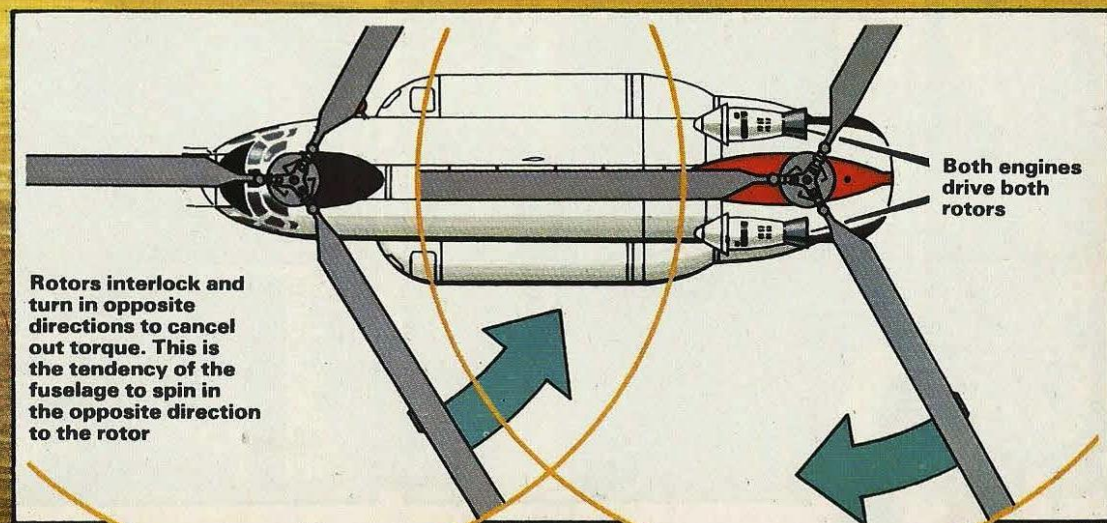
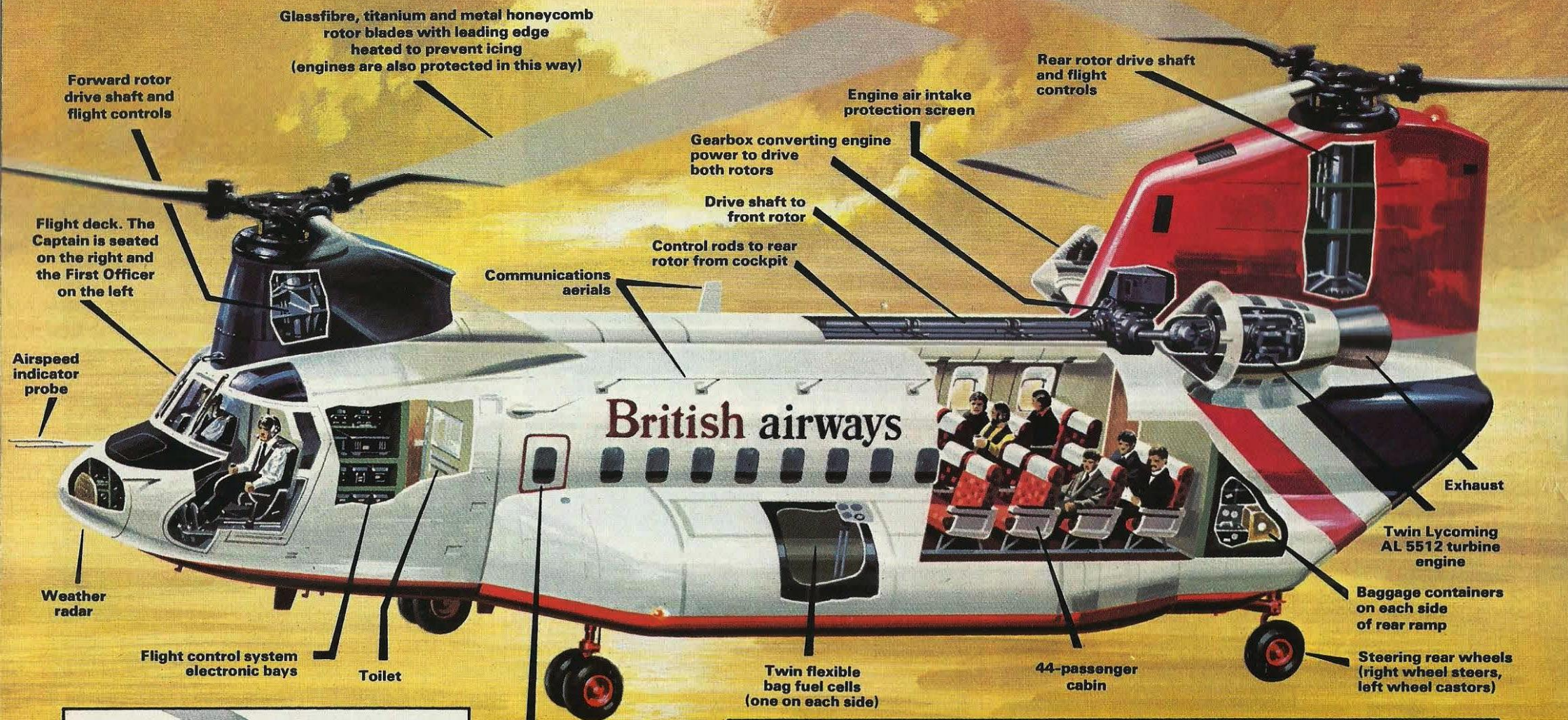
11 Scharnhorst. A typical World War II battleship, this 26,000-ton German giant carried nine eleven-inch guns and had a belt of armour a foot thick amidships. Completed in 1939, she was sunk in 1943 after attacking a British convoy bound for Russia. Her maximum speed was 27 knots.

12 Savannah. The final cost of building this American nuclear merchant-ship was \$243 million, and she was completed in 1982. The 21,000-ton Savannah can carry sixty passengers and 10,000 tons of cargo—but cost twice as much to build as a similar ship propelled by steam or diesel.

13 U.S.S. Enterprise. Dwarling all the other ships in our picture is the American aircraft-carrier Enterprise, which is the largest ship in the world. She was commissioned in 1961, and cost her builders \$180 million. She is atomic-powered, displaces 85,350 tons, and has a maximum speed of 35 knots. Her striking-power consists of one hundred aircraft.

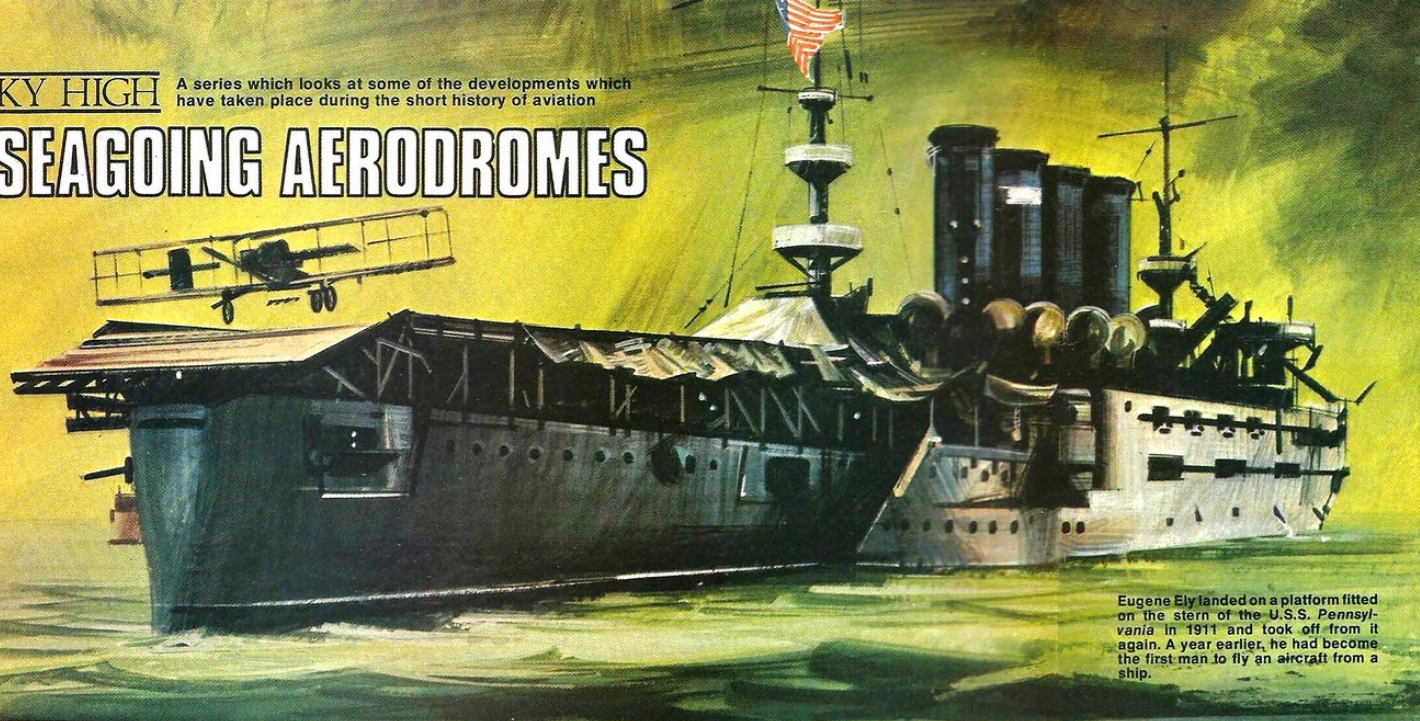
14 Minute in comparison to the Enterprise is the nuclear submarine—yet it carries scarcely less fearsome armament—for its sixteen Polaris missiles, which can be launched while the submarine is still underwater, have destructive power greater than that of all the bombs dropped during World War II.

15 A revolutionary method of sea-travel is the Westland S.R.N. 3 Hovercraft. This craft does not float, except when stationary. Instead its power-units enable it to hover above the water as it travels—thus giving it a greater speed than any ship. Other versions of the Hovercraft have been built, and the S.R.N.3 has a top speed of 70 knots.

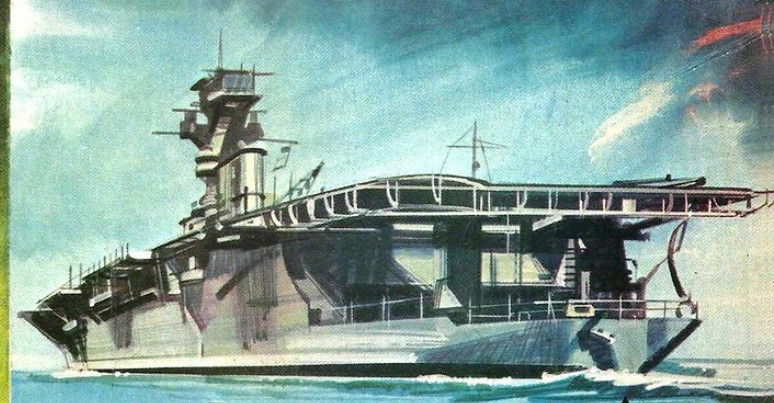


HARRY BO

SEAGOING AERODROMES



Eugene Ely landed on a platform fitted on the stern of the U.S.S. *Pennsylvania* in 1911 and took off from it again. A year earlier, he had become the first man to fly an aircraft from a ship.



H.M.S. *Hermes* was the first British vessel completed as an aircraft carrier. She went into service in 1923 but was sunk during the Second World War off Sri Lanka by Japanese dive-bombers.



H.M.S. *Ark Royal*, seen here with a *Swordfish* torpedo bomber. In 1941, she was torpedoed by a German submarine and later sank.

DIE-HARD admirals snorted derisively when Eugene Ely, an American, became the first man to fly an aircraft from a ship in 1910. What was the navy coming to? But Ely repeated his experiment a year later from the U.S.S. *Pennsylvania* (above), and still the American admirals snorted.

However, the British navy did not ignore the possibility of launching planes from ships. After making trials with aircraft flown from platforms built on battleships, they built Britain's first aircraft carrier. This was H.M.S. *Hermes* which was laid down as a cruiser in 1918 and completed as a carrier in 1923.

After a fine fighting record in the Second World War, *Hermes* was sunk by Japanese dive bombers off Sri Lanka in 1942. Another

fine British aircraft carrier was the *Ark Royal* which the Germans claimed many times to have sunk in the Second World War. They finally did so in November, 1941. Another carrier bearing this name was completed in 1955.

After their initial reluctance, the Americans also developed some fine aircraft carriers. Now they are experimenting with air-cushioned carriers built upon the hovercraft principle. These may be the pattern of aircraft carriers of the future, for they will be able to race to a battle area and launch their planes within operational range of their target. It is like having a floating aerodrome in the enemy's backyard — and as such it should be a potent deterrent to a potential aggressor.

NEXT WEEK: A DREAM TAKES FLIGHT

A floating aerodrome which can sail into the enemy's backyard at speed should be a potent deterrent to any potential aggressor

Sea Vixen, the first British naval aircraft to be fitted with Firestreak guided missiles. They first became operational with H.M.S. *Victorious* in 1958.

An American jet plane flies off from the latest development in aircraft carriers (bottom).



Aircraft carriers of the future may follow the pattern of this American air cushion craft which combines size with speed.

After good service in the Second World War, H.M.S. *Victorious* was rebuilt into a thoroughly modern fighting unit.





Wilf Hardy

One of Britain's leading technical artists presents a weekly look at the world of science and technology

HARDY'S DRAWING BOARD

Wings That Swing

— ANY AIRCRAFT DESIGNED WITH A FIXED WING IS A COMPROMISE BETWEEN MANY DEMANDS. A FIGHTING AIRCRAFT MUST TAKE OFF FULLY-LOADED (AND LAND) SAFELY IN THE SHORTEST POSSIBLE DISTANCE, FLY FOR LONG DISTANCES AT HIGH CRUISING SPEED USING MINIMUM FUEL, AND ACCELERATE SUDDENLY TO TWICE THE SPEED OF SOUND. THE SWING-WING ALLOWS THE PILOT TO "RE-DESIGN" HIS WING IN THE SKY TO MATCH ALL THESE NEEDS.

SLOW, SAFE TAKE-OFF AND LANDING

CRUISING AND BEST FUEL CONSUMPTION

HIGH SPEED AND "LOW DOWN" SMOOTHEST RIDE

THIS MEDIUM-SWEEP WING GIVES THE BEST CONTINUOUS CRUISING AND FUEL CONSUMPTION SPEED

THE SHARPLY-SWEEP DELTA WING IS BEST FOR VERY HIGH SPEEDS AND FOR RIDING ROUGH AIR TURBULENCE AT TREE-TOP HEIGHT BECAUSE THE WING'S AREA IS AT A MINIMUM FOR THE AIR CURRENTS TO BUFFET.

THIS STRAIGHT WING IS BEST FOR GOOD, SAFE TAKE-OFF AND LANDING AT LOW SPEED

THE WING PIVOT-BOX MUST BE EXCEPTIONALLY STRONG—IN THE TORNADO IT'S MADE OF TITANIUM

TORNADO

PIVOT POINT

THESE RODS ENSURE BOTH WINGS "SWING" EQUALLY

THESE RODS PUSH AND PULL THE WINGS TO SWEEP THEM FORWARD OR BACK

FIRST PRACTICAL WORKING SWING-WING

LONG EXTENDING WING FOR TAKE-OFF AND LANDING

THE IDEA OF CHANGING WING SHAPE IN FLIGHT IS NOT NEW. THE FIRST EFFECTIVE DESIGN WAS BUILT IN 1931 BY A RUSSIAN, IVAN MAKHONINE, LIVING IN FRANCE. IT WORKED WELL UNTIL IN 1941 THE OCCUPYING GERMANS BEGAN TO BE INTERESTED—THE FRENCH THEN DESTROYED IT IN A DELIBERATE CRASH!

AMERICAN 1950'S EXPERIMENTS

AIR FORCE BELL X-5

NAVY GRUMMAN XF10F-1 JAGUAR

MAK-123 ALSO A GOOD GLIDER!

SHORT INNER "GLOVE" WING FOR SPEED

PROPER NAME FOR A "SWING-WING" IS A VARIABLE GEOMETRY WING

WITH WINGS SET AT CRUISE POSITION THE F-2 CAN "LOITER" ON PATROL FOR LONG PERIODS

A TORNADO TAKING OFF—SHOWING THE WINGS FULLY EXTENDED

DROOPED WING LEADING EDGE "SLATS" EXTENDED TO INCREASE LIFT

TRAILING EDGE "FLAP" LOWERED TO INCREASE THE AREA OF THE WING, CREATING MORE LIFT FOR LOAD-CARRYING ON TAKE-OFF AND SAFE LANDING.

NOTE MAIN WHEELS TURNING AS THEY RETRACT TO LIE FLAT IN FUSELAGE

BOTH SLATS AND FLAPS SLIDE CLEANLY INTO THE WING WHEN NOT IN ACTION

WING FULLY SWEEP IN HIGH SPEED POSITION

LATEST VERSION OF THE "SWING-WING" TORNADO IS THIS F-2. IT WILL BE U.K.'S MAIN AIR DEFENCE SHIELD PROBABLY UP TO THE YEAR 2000+ AND IS NOW IN TEST FLIGHT STAGE

U.S. NAVY/GRUMMAN F-14 "TOMCAT" (CARRIER-BORNE)

OTHER PEOPLE'S SWING-WINGS

RUSSIAN TUPOLEV TU-22M "BACKFIRE B" (NATO NAME)

BOEING MODEL 733-290

NO COMMERCIAL AIRLINER HAS YET FLOWN WITH SWING-WINGS. THIS IS A 1960'S BOEING PROJECT—ALL TITANIUM AND 2000+ M.P.H.

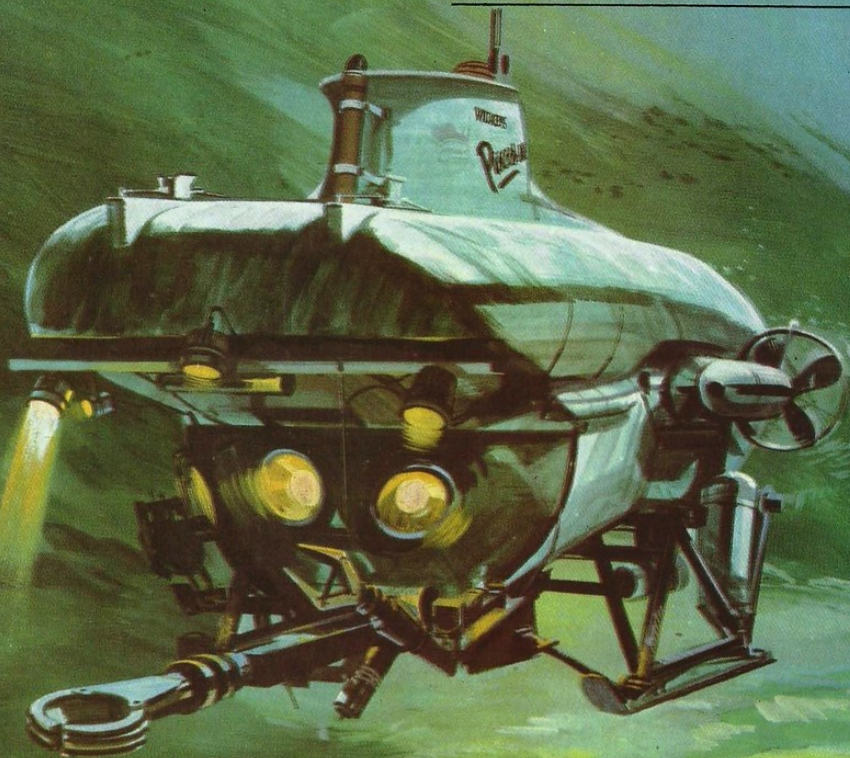
SLEW-WING WARTIME GERMAN BLOHM UND VOSS P202 PROJECT

YOU DON'T HAVE TO SWEEP TWO WINGS BACK EQUALLY. AMERICA'S NASA* IS TEST FLYING THE AD-1 "SLEW-WING" ON WHICH THE WING SWINGS IN ONE PIECE OBliquely FROM STRAIGHT TO 60° WIND TUNNEL TESTS AND CALCULATIONS SUGGEST SUCH A WING WOULD HALVE FUEL USE AT 1,000 M.P.H.

STRAIGHT

* NASA = NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
— RESPONSIBLE FOR ALL AMERICAN SPACE PROGRAMMES AND FLIGHT RESEARCH.

Modern Marvels



THE UNDERSEA WORKHORSE

This is the Vickers mini-sub, an undersea workhorse which is now helping the Post Office to lay and bury a new transatlantic telephone cable in deep water off the Canadian coast.

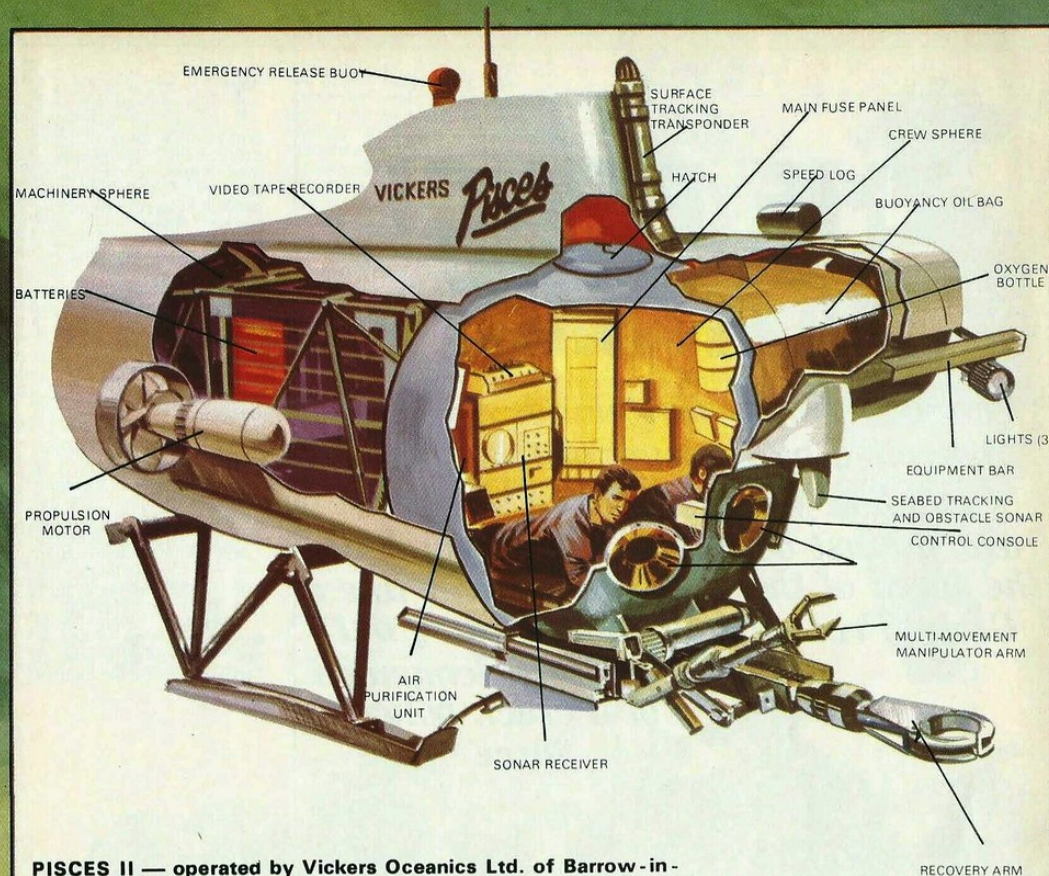
AT this moment a midget submarine is hard at work on the seabed off the Canadian coast. The submarine is working for the Post Office and is helping to bury Cantat 2, a new undersea telephone cable which will link Britain and Canada. The midget submarine, built by Vickers Oceanics of Barrow-in-Furness, has a two-man crew who work in conjunction with a cable ship, burying a 170 mile-long section of the cable beneath the ocean floor of the Canadian continental shelf.

The Post Office cable ship, equipped

with a seabed plough, is able to bury the cable to a depth of 12 to 18 inches. It is, however, unable to bury the torpedo-shaped repeaters, spliced into the cable at regular intervals to boost the power of the signals passing through it. These are simply laid on the seabed. Then the submarine, powered by electrically-driven propellers, sinks down and uses powerful water jets controlled from inside to wash away sand and mud, forming a trench into which the repeater can sink. Then the jets push back the sand and the undersea burial is complete.

The submarine, one of three different types operated by Vickers, can operate down to a depth of 3,500 feet. Its descent and ascent are controlled by a bag of oil inside a compartment which is open to the sea. To descend, oil is pumped out of the bag, allowing seawater to enter the compartment as ballast. To ascend, the

The Post Office estimate that by 1980 nearly 31 million transatlantic calls will be made a year. Some idea of the growth of the telephone can be gained from this picture of Croydon exchange in 1884, which served only a handful of subscribers out of 100,000 people. Today the same exchange handles 338,000 calls per day from over 100,000 subscribers.



PISCES II — operated by Vickers Oceanics Ltd. of Barrow-in-Furness, Lancashire

A cutaway view of the mini submarine which is able to operate underwater for 8 to 10 hours at a time and down to a depth of 3,500 feet. Batteries power the electric propulsion motors, the lights and television equipment. The two mechanical arms are controlled by the crew lying on couches behind the thick viewing ports. The amount of seawater ballast is controlled by oil bags which can be filled or emptied by pumps and the crew breathe air which is recirculated by an air purification unit.

reverse operation takes place; the bag is filled and the seawater displaced.

The position of the submarine on the seabed is constantly monitored by the surface cable ship through the submarine's transponder. This sends out a signal that appears as a "blip" on a screen which can then be plotted. A sonar system fitted to the submarine is used to navigate across the seabed, picking up obstacles ahead of the vessel and "locking" on to transponders that have been laid down to mark the path of the cable.

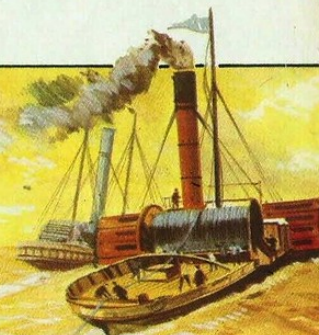
Two mechanical arms are fitted. One is used to help recover repeaters should repairs be necessary, although their life expectancy is over 20 years. The other arm, which can be made to move in six different directions, is used to lift the cable for the same purpose.

Every move made by the submarine is televised by a camera which records on

video-tape, so that the Post Office will have a visual record of the work carried out.

In the unlikely event of the submarine becoming stranded on the seabed, an emergency buoy can be released which will float to the surface to mark the position. In this predicament the crew will have enough air to last them 72 hours.

The decision to bury the "shore end" of Cantat 2 was made by the Post Office and the Canadian Overseas Telecommunications Company because of the need to avoid damage to the high-capacity cable. Cantat 2 will carry up to 1,840 telephone calls at once. This is more than twice as many calls as all the other transatlantic cables combined, and it would be particularly vulnerable to damage by trawlers operating in the rich fishing grounds off the Canadian shelf. The burying of the cable at the United Kingdom end is also being considered.



Paying out the first cable across the English Channel in 1851. Fifteen years later the first telegraphic cable across the Atlantic was laid. The maximum speed at which a message could be sent was 15 words per minute. The new Cantat 2 will carry 1,840 telephone calls simultaneously.